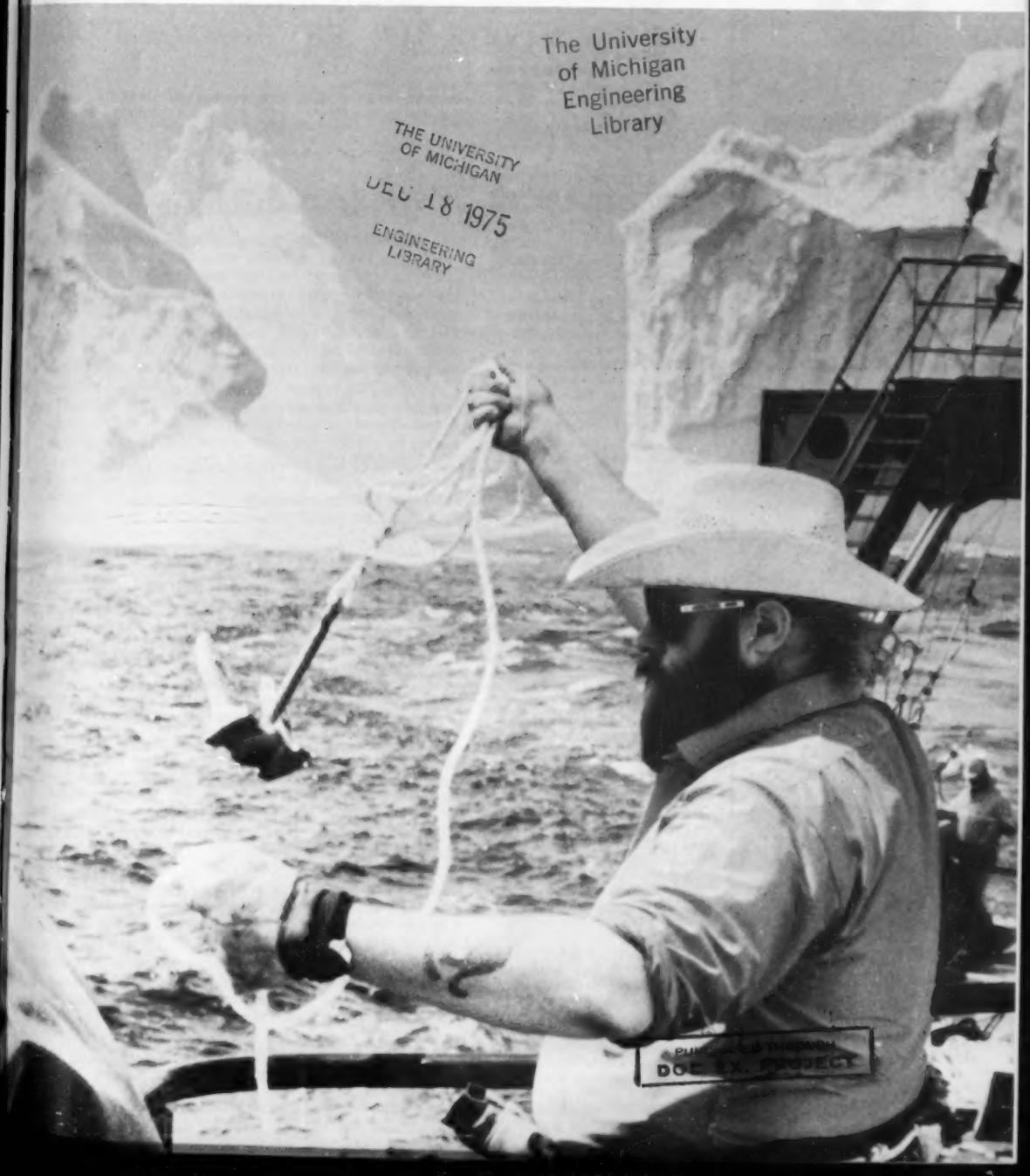
November 1974
Volume 18
Number 6

Mariners Weather Log

DEC 17 1975

National Oceanic and Atmospheric Administration • Environmental Data Service



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Cover: It's roundup time in the North Atlantic. The HUDSON SERVICE is one of two ships protecting the drilling rig HAVDRILL from bergs. The rig is exploring for oil off of Newfoundland where icebergs are one of the hazards of the trade. See item on Editor's Desk on the 1,400 bergs that menaced North Atlantic shipping in 1974 on page 386. Wide World Photo.

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The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget through June 30, 1975.

Copies are available to persons or agencies with a marine interest from the Envrionmental Data Service, Page Building 1 (D762), 2001 Wisconsin Ave., N.W., Washington, D.C. 20235.

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Mariners Weather Log

Editor: Elwyn E. Wilson

Editorial Assistant: Margaret H. Hare

November 1974
Volume 18 Number 6
Washington, D.C.

Routing
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Observing Officers
_____ _____
_____
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Radio Officer _____

PARTICIPATE IN AMVER

PLEASE PASS THIS ISSUE ALONG

Mariners Weather Log

DANGEROUS WAVES ALONG NORTH WALL OF THE GULF STREAM

R. W. James
U. S. Naval Oceanographic Office
Washington, D.C.

In spite of the increased use of weather satellites to locate and track storms over the ocean, ships still encounter heavy weather and, on occasion, founder. A partial explanation for these mishaps is that the ship is overwhelmed by the violence of a storm, which at first appears no different than many other storms the Master has successfully transitted with his ship. The reason for this is that under certain conditions, storms of the same size and isobaric configuration can differ considerably in their surface wind and seaway characteristics.

An example of this can be found on the Great Lakes where autumn storms are feared far more than storms of the same size that occur during the remainder of the year. The reason is that, in the autumn, the water is still warm from summer heating while the land, which cools more rapidly, is a source for cold air that can be carried over the Lakes. The result is a turbulent unstable wind field as the cold air flowing over the water is immediately warmed, and rises to be replaced by colder air from aloft. This descending air also brings down the stronger winds from above by momentum transfer, creating increased surface wind speeds. Wind speeds observed by a ship 10 mi off the coast may double from the value reported by shore stations, and exhibit considerably more turbulence. Damage to ships and losses of ships have been most frequent during the autumn months owing to this phenomenon (Strong and Bellaire, 1965). During the remainder of the year, differences between water and air temperatures are smaller so that extreme instabilities are not as likely to occur. In spring, the water is generally colder than the land, thereby producing stable conditions near the surface and surface winds that are diminished in both strength and gustiness.

Another example of variability is found off the U. S. east coast where certain coastal storms are particularly changed by the Gulf Stream. The warm current acts in two ways: (a) affecting the winds through the creation of unstable conditions, and (b) modifying the waves by the interaction between the wave and current velocities. These phenomena are particularly enhanced in the North Wall, a narrow band of extreme horizontal water temperature change marking the north edge of the Gulf Stream (fig. 1). The North Wall also indicates the region where strong, northeasterly currents will be encountered that reach a maximum value within the next 10 to 20 mi into the Gulf Stream. As reported by Cormier and Kindle (1970), "Marine mete-

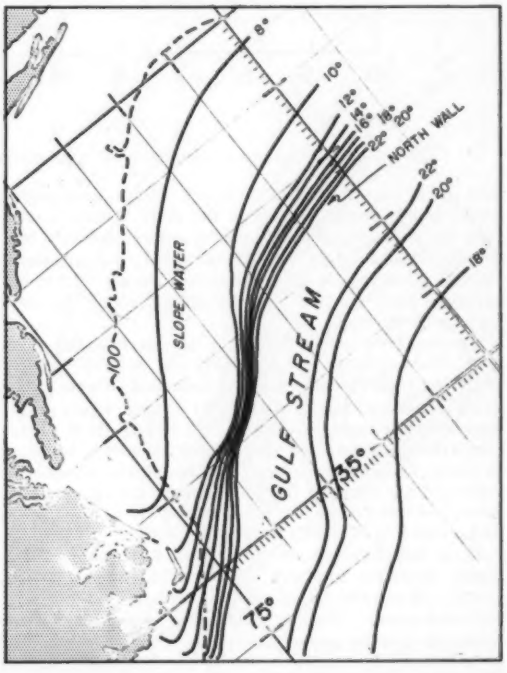

Figure 1. -- Sea-surface temperature analysis of March 27, 1971, showing North Wall of Gulf Stream and slope water. Temperatures in °C.

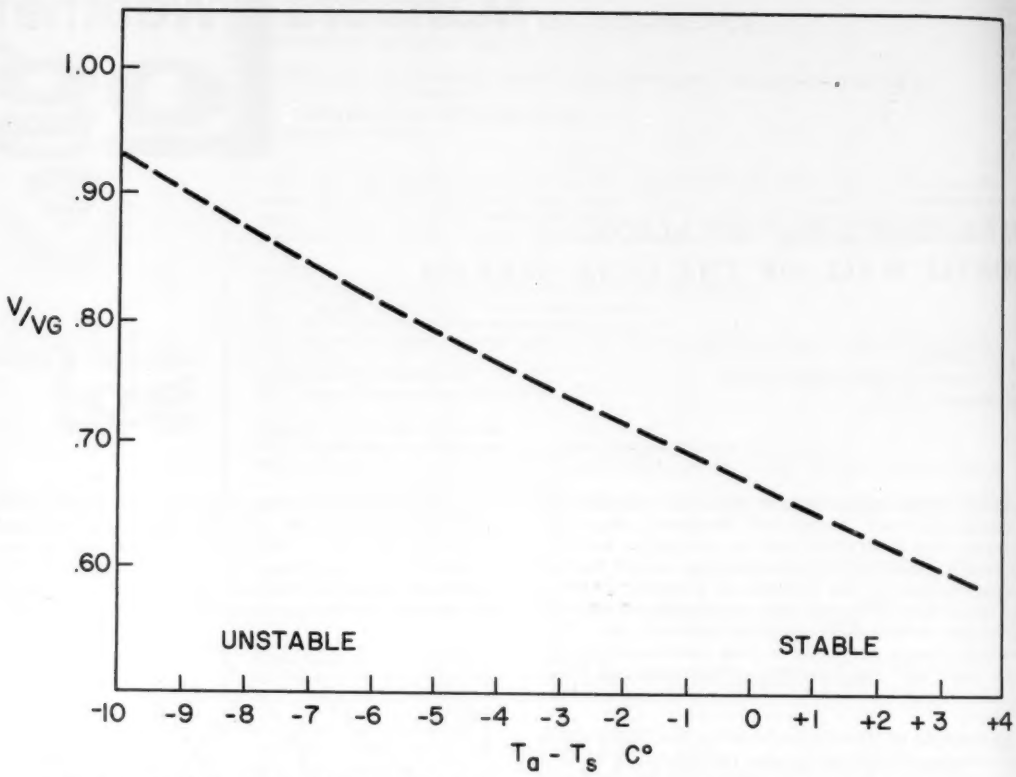

Figure 2.--Surface wind-geostrophic wind ratio as a function of air-sea temperature difference.

orologists have reported frequent trouble forecasting winds at the northern edge of the Gulf Stream during cold air outbreaks in early winter. Surface winds frequently in excess of, and up to twice, the predicted surface geostrophic value have been noted within apparently very limited regions at and along the Gulf Stream North Wall."

During February and March, the waters to the north of the Gulf Stream (slope water) are at their coldest while the Gulf Stream remains relatively warm owing to the continued influx of tropical water. When an intense coastal storm develops, cold Arctic air is sometimes drawn across the slope water and along the coast to Cape Hatteras by strong northeasterly winds. As this cold air reaches the Gulf Stream water temperatures increase suddenly from perhaps 8 to 10°C in the slope water to 20 to 22°C in the Gulf Stream. This 12°C jump in temperature causes sudden warming and thus highly unstable air and, as over the Great Lakes, greatly increased surface winds with more gustiness and turbulence. Higher waves are generated by the increase in wind speed, and these waves are likely to be confused in nature owing to the increased turbulence.

In addition to the increase in wave heights due to instability, more serious changes in the wave characteristics are produced by the currents. The northeasterly seas encounter opposing currents of from 3 to 5 kt and, as is commonly observed in inlets when incoming waves encounter an ebbing tide, the result is sharply increased wave heights and much steeper wave slopes. If the opposing current is sufficiently strong the waves will even break. This steepening action causes problems for small craft navigating inlets with waves of only a few feet in height; with 20- to 30-ft waves the result may be seas dangerous to any ship.

Quantitative relationships have been developed for estimating the magnitude of both of the above effects. In regard to instability, the ratio of surface wind to an upper level wind is related to the air-sea temperature difference.

Wind speed normally increases with height through the boundary layer (0 - 2,000 ft) owing to friction between the moving air and the fixed water surface. Under neutral thermal conditions (where the sea and air temperatures are nearly equal) the surface wind speed is approximately 70 percent of the wind at 2,000 ft, or geostrophic wind. Cold air moving over warm water, however, creates strong vertical exchanges of heat and momentum as the air is warmed from below and rises in convective turbulence. Thus, the strong winds from higher altitudes are brought down to the sea surface as cold air replaces the ascending warm air. As this instability increases, as measured by the increasing air-sea temperature difference, the surface wind speed approaches that of the geostrophic wind. On occasion, the surface wind may even exceed the winds

aloft, but this is rare. Figure 2 shows a typical relationship between the surface wind (V) and the winds aloft (Vg) for various degrees of instability. With a geostrophic wind of 50 kt under stable conditions, for instance, the surface wind may be 30 kt (60 percent), but under unstable conditions it could reach 45 kt (90 percent).

When surface waves encounter water in motion they tend to undergo changes in length, direction, and amplitude. The effect of an opposing current is to decrease the wave lengths, and hence to increase the height of the waves, since the amount of energy remains constant. This produces higher and steeper waves and, with a sufficiently strong current, breaking waves. Wave periods are unchanged since the wave velocity decreases proportionally to decreases in wave lengths.

The degree to which a wave is altered by a current is dependent upon the relative velocities of the current and the waves. This relationship, shown in figure 3, is based on work at the Scripps Institution of Oceanography. The figure shows the possible rapid increase in height for waves encountering an opposing current of appreciable speed, as found in the Gulf Stream. For example, a 15-ft, 8-sec wave entering the Gulf Stream and an opposing current of 3 kt would have a ratio U/Co of -0.125 (Co = 24 kt). According to figure 3, the wave heights would increase by a factor of 1.35 or become 20 ft high. More important, the wave length would decrease by 30 percent so that the wave would be so steep it would most likely break.

As an example of the degree to which stability and currents can alter wave conditions, sample calculations were made for the storm of March 27, 1971. The storm was located about 150 mi off Cape Hatteras, and northeasterly winds and waves of 60 kt and 25 ft, respectively, were reported by ships just north of the Gulf Stream.

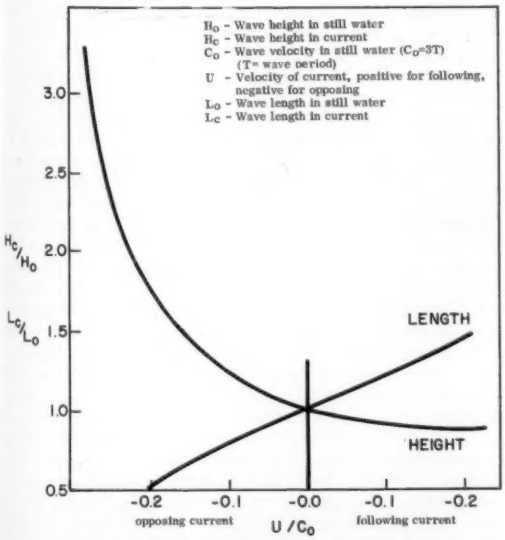

Figure 3.--Change in wave dimensions for opposing and following current.

Figure 4 shows the thermal conditions at this time with cold air (8-12°C) encountering the warm (22°C) waters of the Gulf Stream. With an air-sea temperature difference of -10°C to -12°C the initial effect of the North Wall would be to increase the wind speed through instability mixing. The air was slightly unstable over the slope water (-4°C difference) which meant that the 60-kt surface wind was 75 percent of the geostrophic wind, or the latter was 80 kt (fig. 2). At the North Wall, however, the instability associated with the -10° to -12°C air-sea temperature difference would generate a surface wind close to 94 percent of the upper wind speed, or 75 kt. This increased wind speed over the Gulf Stream would increase the significant wave heights to 30 ft.

At the same time that the wind was accelerating, and the seaway growing due to instability effects on the wind profile, the opposing current was steepening the slope, and increasing the heights of the waves. Assuming a current of 3 to 5 kt, the wave height would increase by a factor of 1.20 to 1.40. Thus, waves of 36 to 40 ft, some breaking, and all extremely steep, would be created in the North Wall.

The most dangerous aspect of this phenomena is that the extremely high and steep waves would occur in a limited area since both the effects of instability and opposing current would be reduced deeper into the Gulf Stream as the air temperature modifies and the

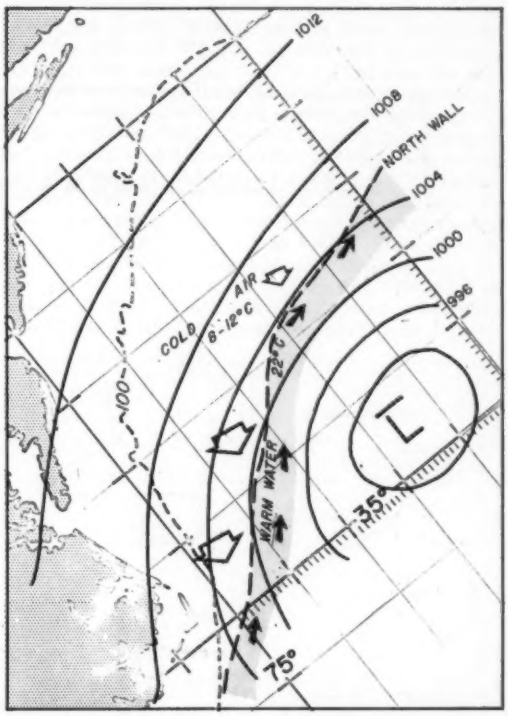

Figure 4.-- Environmental conditions on March 27, 1971, indicating the opposing cold air flowing over the warm northeasterly-moving Gulf Stream.

current drift slows. Thus, a ship that was laboring, but still proceeding on a northerly course, could suddenly encounter rapidly deteriorating conditions. There are numerous cases of ships that have foundered off the coast in the approximate position of the North Wall and, in fact, a ship was lost during this 1971 storm near 36°N, 73.7°W. Effects described in this article may have been the deciding factor. (See the Smooth Log, page 293, Vol. 15, No. 5 of the Mariners Weather Log for a description of this storm.)

What does one do to avoid this problem? First, be aware that it exists and that in regions of strong, warm currents wave conditions may deteriorate rapidly, particularly during cold outbreaks. Second, in late winter and spring, cross the Gulf Stream as far east as possible, since it is more likely that the cold air would have modified somewhat and thus reduced the instability effect farther off the coast.

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Editor's Note: A similar situation occurs off the east coast of South Africa where the strong warm Agulhas Current hits southeasterly winds from winter LOWs off that coast. See "Important Notice, Freak Waves Off South Africa," appearing in the September 1974 issue of the Mariners Weather Log.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

COASTAL WAVE OBSERVATIONS VIA SEISMOMETER

W. H. Quinn, H. C. Creech, and D. O. Zopf
Oregon State University
Corvallis, Oreg.

It now appears technologically and economically feasible to obtain reliable and reasonably accurate all-weather wave observations for critical areas (e.g., harbor entrances) along the Pacific Northwest coast of the U.S. in winter, through the use of seismic sensors. In the past it has been found that the traditional sea-based sensors (e.g., pressure transducers on the sea floor) could not cope with the late fall, winter, and early spring wave and surf conditions. During these periods, either the bottom sensor was covered over through seasonal shifting of sand or the cables were broken as a result of turbulent surf conditions. With such systems, outage time could be large and replacement costs high. In the search for a more reliable and less expensive way of obtaining wave information, the use of a land-based seismometer to infer wave height and period was considered; and, at least at those sites so far tested, it appears that this method is quite effective.

In retrospect, this sensing method was a by-product of earlier research efforts. From 1969 to 1972 Oregon State University was involved in the development of a technique for forecasting wave and surf conditions over the treacherous Columbia River Bar, under a NOAA-National Weather Service contract. From 1971 on, the base for these studies was broadened through NOAA-Sea Grant support to develop a sea and surf forecasting capability for the Pacific Northwest coastal zone of the U. S. Earlier attempts to verify and improve wave forecasting techniques over the more turbulent regions, such as this, relied heavily on hindcast data. In other words, forecasts relied on preliminary analyses and prognostic inputs and the hindcasted verifications on finalized analyses. However, the fallacy of this rather universal approach to verification is that it assumed the forecast technique to be perfect if the input was perfect. Improving the basic forecasting system required routine wave measurements for verifications. All attempts to instrument sites along the Oregon coast with traditional bottom sensors ended in failure. (The U.S. Army Corps of Engineers attempted to instrument the mouth of the Umpqua River and the University attempted to instrument the mouth of the Yaquina River.) This resulted in a search for a less vulnerable and more reliable method of obtaining wave measurements.

It was decided to investigate the utility of measurements made with a long-period vertical seismometer, based on the assumption that the theory of Longuet-Higgins (1950) could be applied in this situation, and realizing that others (Darbyshire, 1950) had found certain correlations long ago. Theory predicts that ocean waves impinging on a sloping beach will experience some reflection, that the interaction of incident and reflected ocean waves will result in the formation of standing waves, and the standing waves will produce a pressure field on the ocean bottom which in turn will generate seismic waves propagating in the horizontal plane. It is assumed that the amplitude of the seismic motion is linearly related to the pressure field, and it is expected to have twice the frequency of the ocean wave which generated it.

Based on the discussed theoretical considerations, a long-period vertical seismometer with a self-timed recorder was installed at the Marine Science Center, Newport, Ore., in May 1971. The initial system was automatically programmed to produce 12-min records on a strip chart at 6-hr intervals. For calibration tests on the system, visual observations were made against a 4-m-high buoy located in 20 m of water about 2 km offshore (fig. 5). An observer located on a hill about 40 m above sea level and 3 km from the buoy, observed the buoy through binoculars; and by knowing the height of various features of the buoy, estimated the height and period of the highest 10 percent of the waves passing the buoy. On other occasions, test wave data were also obtained from a portable bottom-mounted pressure sensor system and a sensitive fathometer operated from the University of Oregon ship PAIUTE near the buoy. Using 1971-72 data, the regression of visually observed wave heights (H_O) on seismometer inferred wave heights (H_S) was found to be $H_O = 1.07\ H_S - 0.87$ (ft) with a correlation coefficient of 0.87 and a standard error of estimate of 1.61 ft.

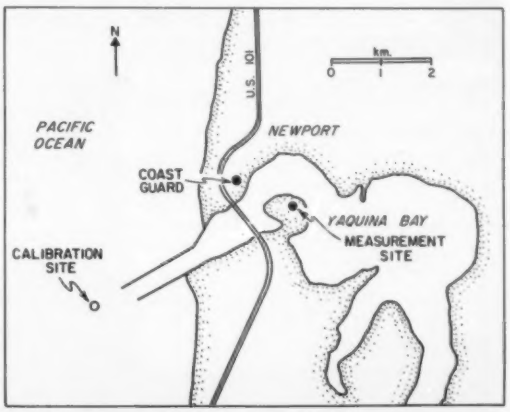

Figure 5.--Location of calibration site.

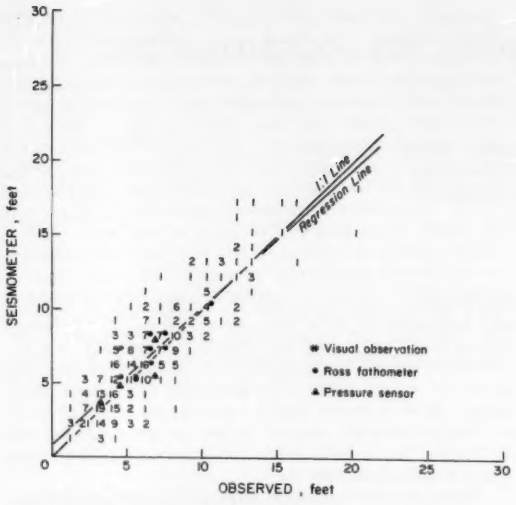

Figure 6.--Relationship between observed wave heights and seismometer-inferred wave heights.

Figure 6 is a scatter plot of the data. Data for 1973 and 1974 confirm this correlation. A similar comparison of ocean wave periods confirmed the 2:1 relationship discussed earlier. After calibration, a meter was designed from which wave height and period could be obtained (fig. 7).

The 2 yr of data from the Yaquina River mouth, one winter's data from near the Columbia River mouth, and recent data from the mouth of the Umpqua River indicate that wave height and period can be inferred from the output of a properly located vertical seismometer. If an earthquake occurs during the recording period, it shows up on the recorder chart as extremely large amplitude fluctuations with a period of about 18 sec, which is much longer than the half-periods of waves (2-9 sec) as sensed by this system. Hence, it is easy to screen out disturbances of this nature.

The advantages of this wave sensing system are summarized as follows:

1. It has high reliability (outage negligible) and is sufficiently accurate for operational use.
2. Its utility is not limited during extremes in sea or weather conditions.
3. Operational characteristics do not appear to be affected by the sizeable tidal variations along the Oregon coast.

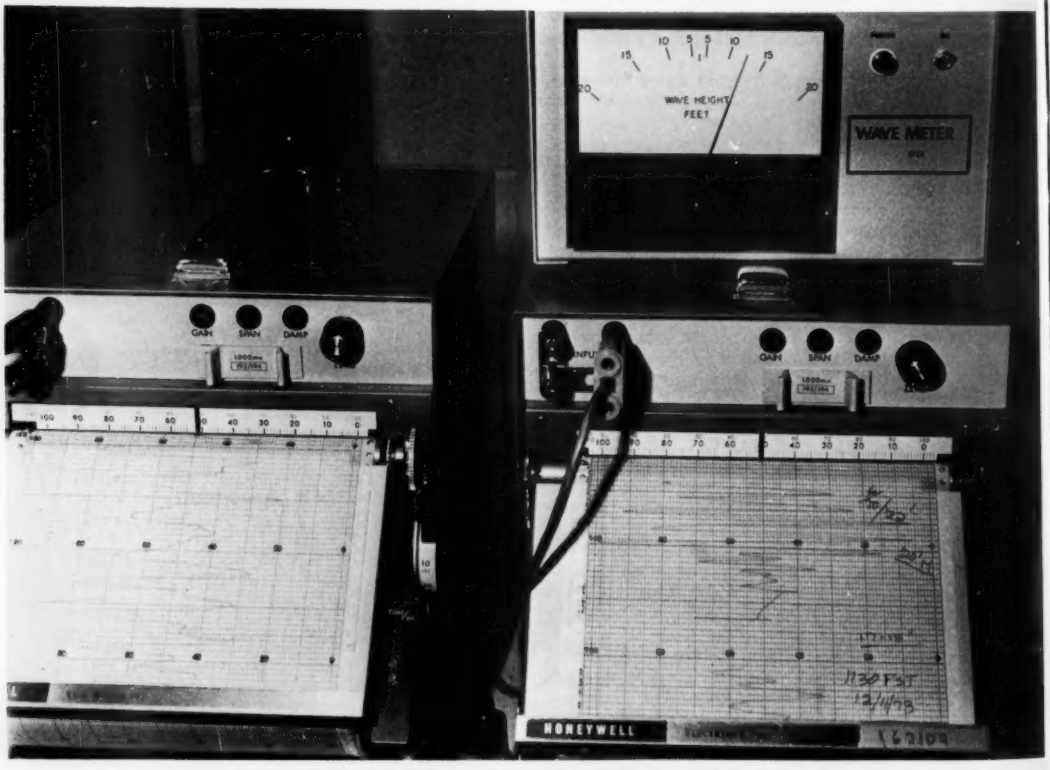

Figure 7.--The wave meter registering a 12.5-ft wave.

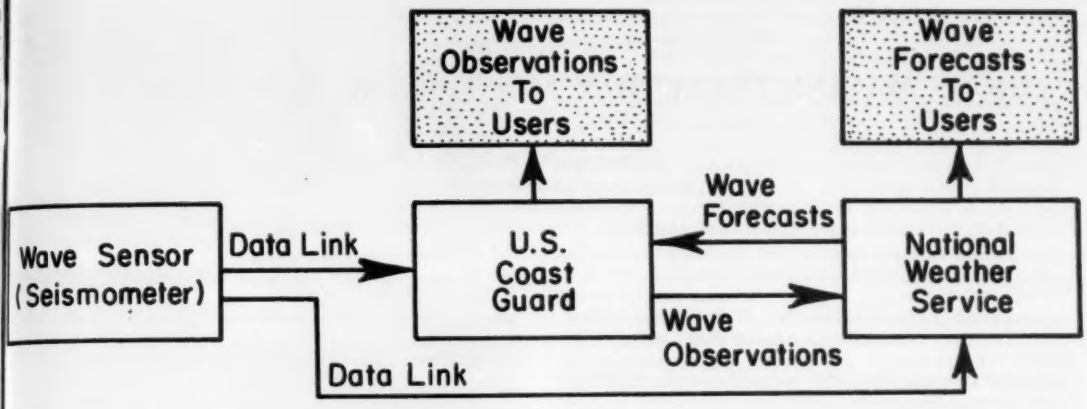

Figure 8.--Chart showing proposed flow of wave information from seismometer sensing sites to users. Data will be transmitted via telephone data links to U.S. Coast Guard and National Weather Service.

4. Equipment is not subject to loss, since it is not exposed to ocean currents, turbulent surf, shifting sands, etc.
5. Initial cost of system procurement and installation is relatively small in comparison to costs for traditional wave sensing systems.
6. Maintenance and servicing costs are small.

Figure 8 shows a currently proposed flow of coastal wave information under Oregon State University's Sea Grant development program. Present plans under the Sea Grant program are:

1. To test this system at additional sites along the coast of the northwestern U.S. (e.g., the Cape Disappointment Coast Guard Station at the Columbia River mouth, the Grays Harbor C.G. Station at Westport, Wash., and the Coos Bay C.G. Station at Charleston, Oreg.).
2. To establish permanent wave sensing sites along those parts of the northwestern U.S. coast which are of most critical interest to mariners.
3. To make wave information readily available on a real-time basis to the U.S. Coast Guard, National Weather Service, ships at sea, and the marine community in general.

ACKNOWLEDGEMENTS

Supported in part by the National Oceanic and Atmospheric Administration (maintained by the U. S. Department of Commerce) Institutional Sea Grant 04-3-158-4.

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THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

IGOSS MARINE POLLUTION MONITORING PILOT PROJECT

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Marine pollution is a worldwide problem, It is a threat to fisheries, recreation sites, and environmental values, and may pose dangers to human health. Unfortunately, little is known about these myriad effects. The problems are intensifying because populations are expanding; the oceans are increasingly used for the transport of fuel and minerals; seabed oil and gas drilling is growing; and on the horizon is seabed mining. All may have polluting effects.

Such a worldwide problem must be dealt with on a global basis. A worldwide system for monitoring petroleum in the oceans is scheduled to begin in January 1975. This will be the very first attempt to monitor a marine pollutant on a global scale.

This Pilot Project is aimed toward the development of organizational machinery and experience needed in the formulation of any coordinated exercise on marine pollution monitoring. The selected vehicle for the project is petroleum-derived oils, since currently they are being monitored to some degree by various national authorities and within several regional frameworks. These nations, which have developed widely varying degrees of expertise through these oil monitoring investigations, will all be able to become involved.

The eventual nature and scale of the monitoring will depend upon the conduct of suitable baseline surveys to delineate areas of significant contamination, which, when taken together with adequate data on pollutant pathways and exposure criteria, will permit the optimal deployment of resources in routine monitoring operations. It may be necessary from time to time to repeat baseline surveys in order to establish long-term trends. We are, however, some way from realizing the later stages of the development of such programs. A start needs to be made now in order to develop the necessary machinery within which to coordinate baseline surveys and develop a monitoring capability to the point where a picture of the distribu-

Figure 9.--A great oil slick trails the bow section of the OCEAN EAGLE while the wreck is under tow off of San Juan, Puerto Rico. More than 2 million gallons of oil spilled into the sea from this wreck. U.S. Coast Guard Photo.

Figure 10. --Contaminants (plastic and tar) with larval fish collected from open ocean surface waters of the Antilles Current, 120 mi east of San Salvador by the ALBATROSS IV, during survey operations in July-August 1972. Plastic debris is shown in round dish at left with fish larvae; oil clumps are shown in dish on upper left.

tion and the dynamics of ocean oil pollution can be obtained on a global scale.

The Pilot Project effort is part of the IGOSS program (Integrated Global Ocean Station System) cosponsored by the United Nations' Intergovernmental Oceanographic Commission (IOC) of UNESCO and the World Meteorological Organization (WMO). IGOSS is a worldwide ocean services system. Data collected by participating countries are made available to a spectrum of ocean users. This is the aim of the Marine Pollution Monitoring Pilot Project: to bring together and coordinate the national activities of various countries, and to develop common methodology into a global organization on marine pollution monitoring.

Within the context of the Pilot Project, the following pollutant types will be included:

1. Oil slicks and other floating pollutants (fig. 9).
2. Floating particulate petroleum residues or "tar balls" (fig. 10).
3. Tar on beaches (fig. 11).
4. Dissolved/dispersed petroleum hydrocarbons in the surface waters (1 m; additional depths are optional) of the ocean.

Observations will also be obtained of sea and air temperatures, wind speed and direction, salinity, pH (acidity), dissolved oxygen, current speed and direction, and wave period and height.

Selected ocean areas for the Pilot Project have been determined from existing national and regional programs, regions of offshore oil production, the main

Figure 11. --The grounding and splitting in two of the OCEAN EAGLE in 1968 resulted in 11 mi of oil-coated resort beaches along the northern coast of Puerto Rico. U.S. Coast Guard Photo.

routes of oil transportation, and the major ocean currents (fig. 12). However, observations from all ocean areas are encouraged.

Efforts are presently underway to coordinate U. S. strategy for involving Federal agencies, academic institutions, and private industry participation in the Pilot Project. It must be realized that new funding resources have not been identified for this effort. Indeed, initially, much of the U.S. response will involve reporting data from ongoing programs. The observations that are called for can generally be worked into existing shipboard schedules with little additional effort. As the Pilot Project evolves, additional sample collections and analyses can be incorporated into ongoing activities as resources permit.

It is envisioned that U.S. participation in the Pilot Project will include the following:

1. Ships from Federal agencies such as NOAA, Coast Guard, and Department of Defense; academic institutions, particularly UNOLS (University - National Oceanographic Laboratory System); and private industry, particularly the merchant fleet through the Cooperative Ship Program and the oil companies. The ships, selected according to capabilities, would be used for reporting visually observable pollutants on a routine basis, collecting samples of particulate petroleum residues, and collecting sea water samples for the subsequent analysis of dissolved petroleum hydrocarbons.

2. Laboratories of Federal agencies and academic institutions. Laboratory participation would involve initially the reporting of data on particulate and dissolved petroleum residues now collected under ongoing programs. Participation would be expanded with the analysis of additional samples.

3. NOAA's National Oceanographic Data Center. NODC will assume the RNODC role, i.e. Responsible NODC, for the receipt, archival, and dissemination of data and for the preparation of data summaries and analyses.

4. The National Bureau of Standards. NBS has indicated its willingness to undertake responsibility for the distribution of standard reference materials and to lead in the development of a laboratory intercomparison program. A full quality assurance program will be required involving NBS and participating laboratories.

Seawater samples for the analysis of dissolved petroleum hydrocarbons will be prepared by extraction with carbon tetrachloride at the time the sample is taken, subsequent evaporation, and extraction into hexane. The recommended procedure for laboratory analysis is a fluorescent technique using a selected wavelength and comparing the sample results with those for standard solutions of hydrocarbons. This relatively unsophisticated technique was selected to ensure broad participation worldwide among countries and facilities that do not have the resources or capabilities to undertake more complicated analyses. This should not preclude the use of more advanced analytical approaches by those laboratories that are capable.

It is expected that U.S. participating ships will begin routine observation and collection programs in accord with the U. S. Operational Plan. In several months, participating ships and laboratories will be receiving data forms and instructions, along with detailed procedures for collection and transmittal of the information obtained. Personnel will be briefed on the scope and objectives of the overall project and on sampling techniques.

In order to provide maximum U. S. participation in the project and maximum compatibility with regular activities and programs, the U.S. plan will be implemented in three phases. The first phase will consist of a reporting scheme for visually observable pollutants and of collection of sampling information from ongoing programs. Data receipt, archival, and dissemination functions will also be included in this phase. Phase I will be started January 1, 1975, when the monitoring Pilot Project (table 1) will begin; further preparations for the implementation of Phases II and III will continue.

As the Pilot Project progresses, it is envisaged

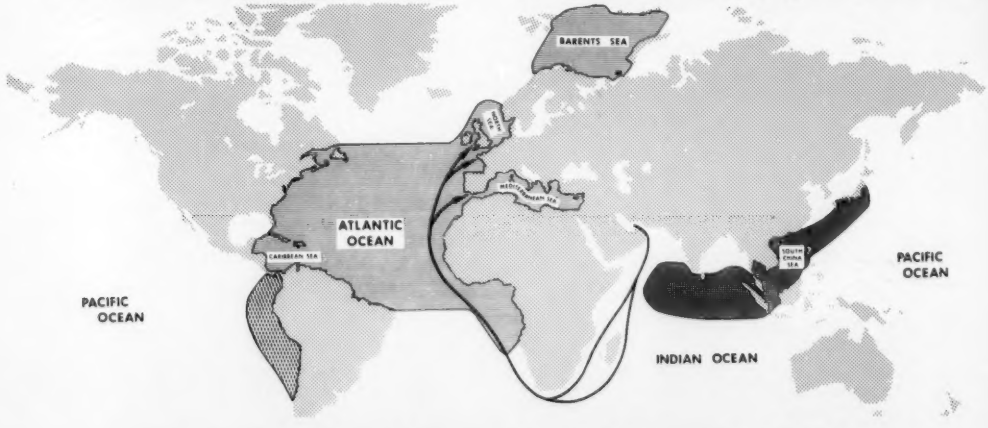

Figure 12. --Area of the world's oceans to be studied in IGOSS oil pollution project.

that major products may be developed as follows:

1. Regular information concerning the horizontal distribution of concentrations of petroleum dissolved in the upper layers of the ocean;
2. Data from fixed points (i.e., OWS) on hydrocarbon concentrations in order to study temporal variations;
3. Regular information on the horizontal distribution of tar balls and oil slicks and other pollutants on the ocean surface.

REFERENCES

"Global Monitoring of Oil in Ocean to Begin," Chemical and Engineering News, June 10, 1974.

Proceedings of the Marine Pollution Monitoring Symposium and Workshop May 13-17, 1974. (To be published October or November 1974.)

Report of the Joint IOC/WMO Task Team II May 20-22, 1974. (To be issued by IOC Secretariat; Operational Plan for the IGOSS Marine Pollutant Monitoring Pilot Project will be an annex to this report.)

Table 1.--Basic Components of the Pilot Project

1. Parameters to be monitored

   (a) Oil slicks and other floating pollutants,
   (b) Floating particulate petroleum residues or "tar balls,"
   (c) Tar on beaches,
   (d) Dissolved/dispersed petroleum hydrocarbons in the surface waters (1 m; additional depths are optional) of the ocean.

2. Complementary environmental information

Primary	Secondary
(a) sea temperature	(a) salinity
(b) air temperature	(b) dissolved oxygen
(c) wind speed and direction	(c) pH
	(d) current speed and direction
	(e) wave period and height

3. Priority areas for monitoring

   (a) The Atlantic Ocean north of 5°S;
   (b) The Caribbean Sea, the North Sea, the Mediterranean Sea, and the Gulf of St. Lawrence;
   (c) The Norwegian Sea and Barents Sea;
   (d) The oil tanker route from the Arabian Sea around the Cape of Good Hope to Europe and the route from the Arabian Sea to Japan;
   (e) An area off the west coast of South America.

   While these priority areas are specifically identified (selected for broad international participation), samples and data from other areas are encouraged and will be included.

4. Means of data acquisition

   (a) Visual observation of oil slicks and other floating pollutants by:
      (1) Ocean weather ships and research vessels,
      (2) Voluntary observing ships, fishing vessels, and their supporting ships,
      (3) Suitable offshore platforms,
      (4) Aircraft
   (b) Tar ball sampling by:
      (1) Ocean weather ships and research vessels,
      (2) Other vessels designated by Member States,
      (3) Coastal stations, islands, and offshore platforms.
   (c) Surveys of tar on beaches.
   (d) Seawater sampling by:
      (1) Research vessels,
      (2) Ocean weather ships,
      (3) Other vessels suitably staffed and equipped.

5. Laboratory network for the analysis of samples

   Member States have been asked by the Secretariats to identify those laboratories or analytical centers participating in the Pilot Project and indicating in each case their involvement and capability with respect to the parameters to be monitored, complementary environmental information, and areas for monitoring, and to identify requirements for technical and other assistance.

6. Products and services

   IGOSS Responsible National Oceanographic Data Center (RNODC's: U.S. NODC, U.S.S.R. NODC, France BNDO, and others to be identified) will undertake the generation of statistical summaries, archival, and retrieval. It is envisaged that major products may be developed as follows:
   (a) Regular information concerning the horizontal distribution of concentrations of petroleum hydrocarbons dissolved in the upper layers of the oceans,
   (b) Data from fixed points (i.e., OWS) on hydrocarbon concentrations in order to study temporal variations,
   (c) Regular information on the horizontal distribution of tar balls and oil slicks and other pollutants on the ocean surface.

7. Period of monitoring

   After a preparatory stage, the monitoring program will begin January 1, 1975, and will continue for a 24-mo period during which it would be expected to intensify.

IMPORTANT NOTICE

SPECIAL COAST GUARD RADIO WATCH FOR VOICE WEATHER AND AMVER REPORTS

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.
and
LCDR John A. Pierson
U.S. Coast Guard
Washington, D.C.

There is a great need for more weather reports from ships and smaller vessels in coastal waters. Many storms originate or intensify greatly in these areas. Frequently, reports from the few coastal weather stations and ships further out to sea are too far from the storm center to provide information on actual weather conditions in the coastal waters. Sometimes if a storm is small and intense, available reports give no clue whatsoever of its existence.

To supplement reports received from the regular weather reporting ships, the National Weather Service is recruiting tugs and other small ships without radio officers to take observations of wind, waves, weather conditions, and visibility on a regular basis at synoptic observation times, i.e., 0000, 0600, 1200, and 1800 GMT. Seawater temperature, air temperature, and atmospheric pressure are optional. The weather reports are recorded in a standardized plain language format on NOAA Form 72-5b and transmitted to shore by radiotelephone (fig. 13).

The Coast Guard has established a continuous radio watch on single sideband high-frequency bands (radiotelephone) for the purpose of gathering these reports. Initially, the watch will be maintained at Coast Guard radio stations at New Orleans, Washington, D.C., Honolulu, and San Francisco. If ships respond to the program, and traffic warrants, the program will be expanded to include radio stations at Boston and Kodiak, Alaska.

The frequencies shown in the following table were selected on the basis of traffic load and propagation characteristics. Transmissions should reach in excess of 400 mi.

Radio Station
NMH, Washington, D.C.
NMG, New Orleans, La.
NMC, San Francisco, Calif.
NMO, Honolulu, Hawaii

DUPLEX CALLING AND WORKING FREQUENCIES (kHz)
(Single Sideband, Suppressed Carrier - 2.8 A3J)

Coast Station		Ship	
4394.8 6523.2 8762.2	24 hr/day	4096.2 6208.6 8228.2	24 hr/day
13145.4 17291.4	If needed	12366.4 16496.4	If needed

Note: The frequencies listed are assigned frequencies. The carrier frequency is 1.4 kHz below the assigned frequency.

In addition to being used for collection of marine weather observations, the same frequencies will provide for collection of voice AMVER reports and for contacting Coast Guard long-range radio stations for coordination of administrative communications matters. There are many indications that there is a need for a full-time high-frequency single sideband watch by Coast Guard long-range stations; the decision on whether to establish a permanent watch will depend heavily on the degree of participation in the AMVER and weather reporting programs by tugs and other single sideband equipped vessels.

The assistance of shipping companies or individual vessels is solicited. Anyone interested in participating in the program should contact one of the National Weather Service Port Meteorological Officers listed on page 375, or the Office of Technical Services (W52), National Weather Service, 8060 13th Street, Silver Spring, Md. 20910.

NOAA FORM 72-5b (4-74) — U. S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION — FORM APPROVED O.M.B. No. 41-R2734

MARINE COASTAL WEATHER LOG——SHIP STATION

SHIP NAME | RADIO CALL SIGN | DATE (month and year)

(1) DATE	(2) TIME (GMT)	(3) POSITION	(4) PRESENT WEATHER	(5) VISIBILITY (MI)	(6) WIND DIR. (16 pts)	(6) WIND SPEED (Kts)	(7) STATE OF SEA WAVE HEIGHT (Ft)	(7) STATE OF SEA SWELL DIRECTION (8 Pts)	(7) STATE OF SEA SWELL HEIGHT (Ft)	(8) SEA WATER TEMP. ☐C ☐F	(9) AIR TEMP. ☐C ☐F	(10) PRESSURE	(11) REMARKS (Icing, etc.)

Figure 13. --Marine Coastal Weather Log for ships transmitting radiotelephone messages.

ADDRESSES OF NATIONAL WEATHER SERVICE PORT METEOROLOGICAL OFFICES

NOAA National Weather Service Port Meteorological Offices have personnel who visit ships in port to check and calibrate barometers and other meteorological instruments. In addition, port meteorologists assist masters and mates with problems regarding weather observations, preparation of weather maps, and forecasts. Meteorological manuals, forms, and some instruments are also provided.

ATLANTIC AREA

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National Weather Service, NOAA
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212-971-5569

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Mr. David Harmon
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National Weather Service, NOAA
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713-722-7511

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Cristobal, Canal Zone
3-1565

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National Weather Service, NOAA
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206-442-5447

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Port Meteorological Officer
National Weather Service, NOAA
2544 Custom House
300 South Ferry Street
San Pedro, Calif. 90731
213-548-2539

Hints to the Observer

SUPERSTRUCTURE ICING AND SEA ICE

No shipmaster or ship's personnel need be told of the problems or hazards that sea ice or superstructure icing may present. The 1960 International Convention for Safety of Life at Sea specifies that ship masters are bound to report to the closest shore station incidents of gale-force winds causing severe ice accretion on superstructures and the occurrence of dangerous sea ice, including icebergs. Provision is made in the International Ship Code for reporting ice conditions in "code" or plain language. Coded language is used for the ice accretion group ($2I_sE_sE_sR_s$) and coded or plain language may be used for the sea ice group (ICE C_2KD_1re). When observed, either or both groups are added to the ship's code and to Form 72-1 in column 40. For an explanation of the coded symbols see Chapter 10 of Weather Service Observing Handbook No. 1.

Little can be said about sea ice except that ships involved in high- and midlatitude operations should see the series of articles on Sea Ice appearing in the November 1973 and July 1974 issues of the Mariners Weather Log to obtain the various forecasting services available.

Superstructure ice accretion is a complex process that depends on sea conditions, atmospheric conditions, and the ship's size and behavior. Icing can be caused by heavy sea spray, freezing rain, or fog.

Freezing sea spray is by far the most common and dangerous form of icing. It can occur when the air temperature falls below the freezing temperature of seawater (usually about -2°C) and sea-surface temperatures are below about 5°C. If air temperature falls below about -18°C, wind-induced spray may freeze before striking the ship and not adhere. In general, however, the lower the temperature and the stronger the wind, the more rapid the accumulation of ice. The spray generated by the ship herself is added to the spray blown from the wavecaps, so that the total rate of accretion of ice will also depend on the design and loadings of the ship (especially large deck loads), on her heading and speed relative to the waves, and also on the relative wind (which will determine which part of the ship is most exposed). It should be noted that an accumulation of ice will itself increase the rate of accumulation, because the ice already formed increases the effective cross section of rigging, mast, rails, etc., exposed to the spray (fig. 14).

A ship can also encounter icing in freezing rain or a type of fog often called "steam fog." Freezing rain can coat a ship with a freshwater glaze ice the same way it covers trees and roads on land. The weight picked up is usually not enough to endanger a ship, but this ice can make topside conditions dangerous. Steam fog can occur when the air temperature is below freezing and is also considerably colder than the sea. It is usually confined to a layer a few feet thick. Trawlermen call it "white frost" when the top of the layer is below the observer's eye level and "black frost" when it extends above the observer. The small water droplets in this fog are supercooled (exist as water even though the temperature is below freezing) and freeze on contact with the cold ship. Usually, ice accretion by this method is small. However, there are exceptions. The ERNEST HOLT, about 100 mi east of Bjørnøya Island (an island north of Norway) and 20 mi from the ice edge, ran into a dense steam fog. She took 4 in of rime ice on the deck, with up to 12 in on the ship's side at the level of the rail, within a 12-hr period.

Tests by Russians, Japanese, and British have shown that when air temperatures are just below the freezing point of the seawater, ice buildup is slow, and it will not accumulate at more than 1 ton per hour on a 300- to 500-ton vessel, in any wind. On a vessel of this size, a moderate buildup of less than 4 tons per hour will generally occur with air temperatures between -3°C and -8°C, in winds of 16 to 30 kt. When winds exceed 30 kt and temperatures drop below -8°C, conditions are right for an accumulation rate of more than 4 tons per hour on a 300- to 500-ton vessel.

A ship's own observations are a way to check on the threat of icing. If icing is encountered, the buildup rate is a tipoff as to the severity. A rate of up to 3 in per hr can usually be tolerated for a short period. Anything greater than this can quickly create stability problems. For more information, see the article, "Superstructure Icing," in the January 1974 issue of the Mariners Weather Log.

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS

Page 4--Fort Collins, Colo. (WWV): Change the broadcast time to H+08[1], H+09[1], H+10[1]. Amend footnote 1 to read: [1] The three broadcast segments, each of 45 sec duration, are separated by 15-sec intervals during which the time signal is transmitted.

Page 47--Kekaha, Hawaii (WWVH): Change the broadcast time to H+48[1], H+49[1], H+50[1]. Amend footnote 1 to read: [1] The three broadcast segments, each of 45 sec duration, are separated by 15-sec intervals during which the time signal is transmitted.

Page 103-Brentwood, N.Y. (WFH, WFK): In February 1974, a correction was issued to insert under "Schedules," "24-hr surface progno-

Figure 14. --Ice accumulated rapidly on the large bow fender of the tug KINGS POINT while on ice-breaking duty on the relatively mild waters of the Chesapeake Bay. Courtesy Baltimore Sunpapers, Photo by Pearson.

sis/24-hr sea and wind prognosis at 1039 and 2302 GMT." Please change transmission times of this chart to read "1046, 2307."

CORRECTIONS TO PUBLICATION, U. S. AND FOREIGN COASTAL RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATION MESSAGES

Page 18--According to Mr. Norman M. Johnson, radio officer on the GREEN SPRINGS, Radio TXZ, Djibouti, Afars and Issa, accepts only the 1200 GMT weather observations. The most recent information on the station shows the working frequencies are 464, 8570, 8682, and 12782 kHz.

1974 EDITION OF U.S. AND FOREIGN COASTAL RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATION MESSAGES

Sometime in October or November radio officers on all ships in the cooperative weather reporting pro-

gram will be mailed copies of the new edition of U.S. and Foreign Coastal Radio Stations Accepting Ships' Weather Observation Messages. This publication will carry the new title Radio Stations Accepting Ships' Weather Observations. Anyone who fails to receive a copy should request one from the National Weather Service Port Meteorological Office servicing the ship, or from:

NOAA Central Logistics Supply Center (ADF152)
619 Hardesty Street
Kansas City, Mo. 64124

ACKNOWLEDGEMENT OF CORRESPONDENCE

The National Weather Service wants to express its appreciation to the following individuals for reporting on marine weather broadcasts, or on problems encountered in transmitting weather messages to coastal stations:

Norman M. Johnson, Radio Officer, GREEN SPRINGS
Radio Officer (name unknown), MANISTEE (GQOW)
Frank E. Chadsey, Master, WASHINGTON

Hurricane Alley

Richard M. DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

TROPICAL CYCLONE ACTIVITY

In the Southern Hemisphere tropical cyclones during July and August are rare. This season was no exception.

During the monsoon season tropical activity is infrequent in the North Indian Ocean. However, one tropical cyclone formed in August. This system developed in a trough which had dug in over the northern Bay of Bengal on about the 12th. A closed circulation was first noted over the Mouths of the Ganges on the 14th (fig. 15). Central pressure dropped to 985 mb on the 15th as the storm drifted slowly northwestward. Winds near the center reached 35 kt. Although the storm center moved inland its circulation remained intact until the 18th. This storm moved so little that a track was not drawn.

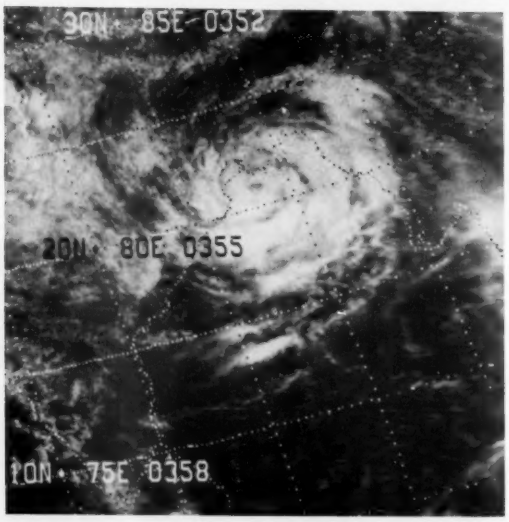


Figure 15. --An infrequent Indian summer cyclone sits over the Mouths of the Ganges on August 14.

SOUTHERN HEMISPHERE OUTLOOK FOR DECEMBER AND JANUARY

These brief climatological summaries are intended to give a quick look at the normal tropical cyclone activity in the Southern Hemisphere, along with one or two anomalies. The climatology is based on information from the Mariners Worldwide Climatic Guide to Tropical Storms at Sea.

In the South Indian Ocean the tropical cyclone season is in full swing by December when in an average year one or two storms will form; they can but usually do not reach hurricane strength. These December tropical storms often form between 5° and 10°S, east of the Seychelles. They tend to move southwestward to near Mauritius then southeastward into the subtropics. A few come close to the Malagasy Republic; even fewer make it into the Mozambique Channel. This is much more likely to occur in January when a second major track extends from near the Seychelles through the Channel then recurves southeastward. January is usually more active than December. Three or four tropical cyclones are likely to develop, one of which usually reaches hurricane strength. The danger of storms in the Mozambique Channel was never more apparent than it was in January 1968 when hurricane Georgette meandered through, taking almost 2 wk. Several ships were trapped near the African coast in winds of 50 to 70 kt. During the night of the 18th the small Italian freighter UT EATIS battled 100-kt winds in heavy seas that completely flooded the deck while showers and sea spray reduced visibility to near zero. The ship was soon out of control even though power was kept at a maximum. Eventually a 40-degree roll was sustained with heavy pitching and vibration from screw racing. The crew hung on through the next morning before winds slackened to 60 kt and the barometer began to rise. The weather continued so rough that it wasn't until the 21st that the Captain could get out on deck to see the damage. One heavy truck had been swept overboard and several had broken loose and collided. Below deck sweat and water took their toll, but considering the pounding the ship came through in good shape. While few January storms reach hurri-

cane intensity in the Channel it only takes one. Hurricanes are more likely around Reunion Island.

In the Southwest Pacific and Australian Region an average of two tropical cyclones form in December and every 2 yr or so one reaches hurricane strength. Activity is sparce off Western Australia and the Northern Territory. If anything develops it is usually a short-lived tropical storm that forms in the Timor Sea and quickly moves inland around Dampier Land. Once in a while one will make it southwestward to the Northwest Cape. Activity is more frequent in the Coral Sea and eastward. A favorite December path runs from the Solomon Sea southeastward across the New Hebrides passing just south of Fiji to the open Pacific. Tropical cyclones also form in the Coral Sea off Queensland, and either come ashore or move southeastward and peter out. December hurricanes are more likely to the east.

January is more active on both sides of the Australian continent. During the first half of the month storms tend to form in the Timor Sea and move southward paralleling but well off the coast. During the latter half of January they tend to hug the coast more, particularly near the North West Cape. Few storms reach hurricane intensity. Tropical cyclones also have a tendency occasionally to form in the Gulf of Carpentaria and move either due south into Queensland or the Northern Territory or move southeastward along the Queensland coast. Another route for early January storms extends from the Gilbert Islands past Fiji and southeastward. During the latter half of the month storms are likely to form off northern Queensland in the Coral Sea and move east-southeastward to New Caledonia and then either continue east-southeastward into the open Pacific or turn southward toward New Zealand. Hurricanes are infrequent and are as likely in one area as another.

In late January 1967 Dinah formed and moved along a path that was not average. She also became a raging hurricane. Dinah formed southeast of the Solomon Islands, moved southwestward, brushed the coast of Queensland before turning toward the southeast and moving across New Zealand. The BARCELONA MARU passed within 20 mi of Dinah in her early stages and was buffeted by 54-kt winds in 20-ft seas. The strongest wind was southeast at 90 kt reported at Cape Moreton on the Queensland coast. Other lighthouses in the vicinity reported 80- to 85-kt winds. Highest wind reports from ships were 75 kt by the CITY OF SYDNEY and the CLUNE PARK. Both of these vessels were some distance from the center and the CITY OF SYDNEY battled 42-ft waves.

On the Editor's Desk

HEAVY RAINS CAUSE PANAMA CANAL SLIDE

The channel in the Panama Canal's Gaillard Cut was nearly closed on October 10 by the waterway's worst landslide in 40 yr. The slide was caused by heavy rains. The mass of earth and rock which slid to within 50 ft of the centerline of the 500-ft-wide channel was estimated at 250,000 cubic yards. It is estimated that some one million cubic yards of earth will have to be moved to stabilize and fully restore the cut and its channel.

One-way ship movements have continued and no real slowdowns have occurred in transits. None are anticipated, unless more slides occur. Other than one-way traffic in the vicinity of the slide, transit activity is normal with no significant reduction in capacity.

The major slide occurred on the east bank of the canal about a mile north of Gold Hill. It extended about 1,500 ft along the bank. It caused shoaling which encroached upon the official navigable depth to within 50 ft of the channel centerline, and projected lesser amounts of material across the centerline for distances up to 100 ft.

Transits were stopped for 2 1/2 hr while surveys confirmed that there were no shoals west of the centerline. Engineers were said to be closely watching the opposite bank "which also has a history of small movements and is potentially unstable."

This is probably the largest slide since November 1931 when the bank adjacent and south of this area broke out in a similar manner. It closed the channel, which was then 300 ft wide, for a period of 2 days. The present slide would have closed the canal to all but very small vessels if the channel had not since been widened to 500 ft.

The company put the cost of removal and stabilization at $2 million and the time required for restoration of the full channel (but with further excavation to permanently stabilize the bank) at up to 3 mo. The channel, it is estimated, will be basically restored to normal use within 3 weeks.

OMEGA: LABORS OF SEVEN NATIONS PROMISE WORLDWIDE NAVIGATION SYSTEM

For hundreds of years, mariners beyond sight of land looked to the heavenly bodies to determine the position of a ship. It was a reliable procedure, but tedious and completely dependent on adequate weather conditions. The development of electronic radionavigation aids helped make position-finding much less laborious, but weather still had an effect, and accuracy was sometimes questionable.

These problems remain, of course, but research in the last 30 yr has produced great strides in electronic systems which a navigator can use reliably and accurately. One of the newest of these is Omega, which, like the widely-used Loran system, consists of a network of stations broadcasting signals which a receiver on a vessel can translate into a line of position, with two or more LOPs giving a position fix. In actual operation, however, the systems are quite different.

For example, Loran stations transmit in pairs, the master station transmitting a pulse first, its slave station second, and the time difference between the

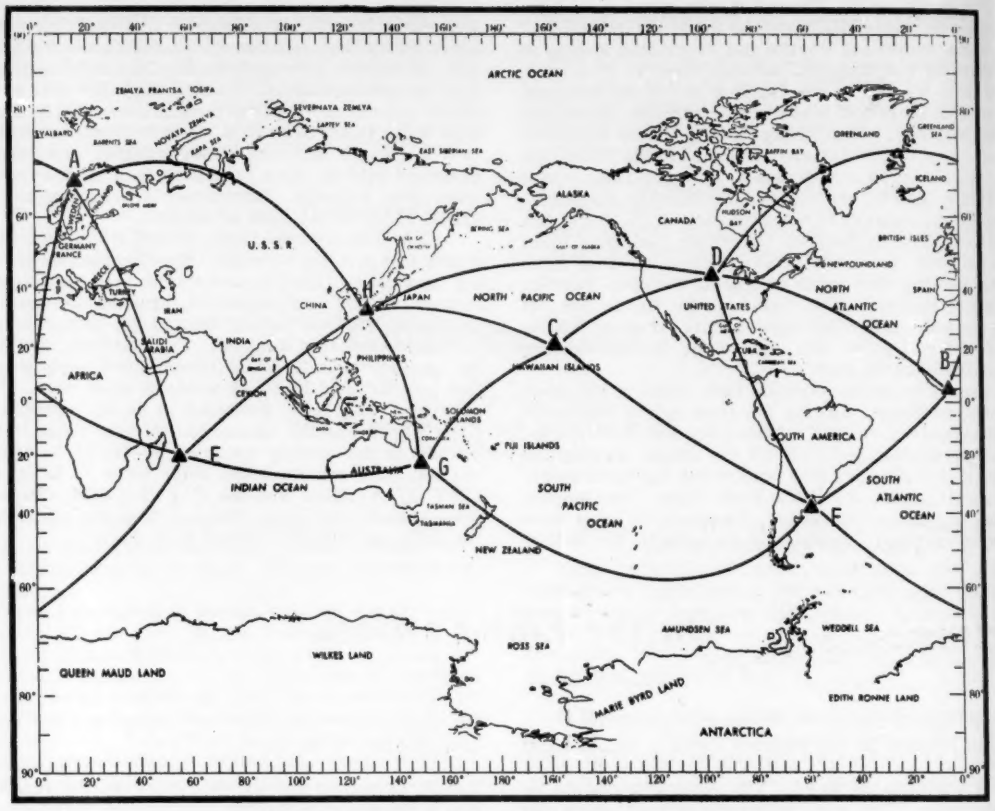


Figure 16. --Planned eight-station Omega configuration.

two as they reach the ship being converted into an LOP. Omega, however, uses the phase difference between radio sine waves to provide LOPs, and as a result any desired combination of two stations within range can be used. Furthermore, Omega is intended for use in the air, on land or water, and aboard submersibles as well.

Using Very Low Frequency (VLF) transmission, each station has enormous range and can be received in all weather, day or night. Three stations are now transmitting--in the State of North Dakota, in Trinidad, and in Norway--while installations in Japan and Hawaii are testing. A total of eight stations (fig. 16) are planned to give the system worldwide coverage, with the remaining three being built in Argentina, the French Island of La Reunion, and Australia, and a Liberian station eventually replacing Trinidad. By 1977, all eight stations, about 5,000 to 6,000 mi apart from each other, should be operating. It will be a truly international endeavor, with each of the seven participating nations retaining full sovereignty over its station, and representatives from each nation forming an International Omega Policy Committee to administer the whole system.

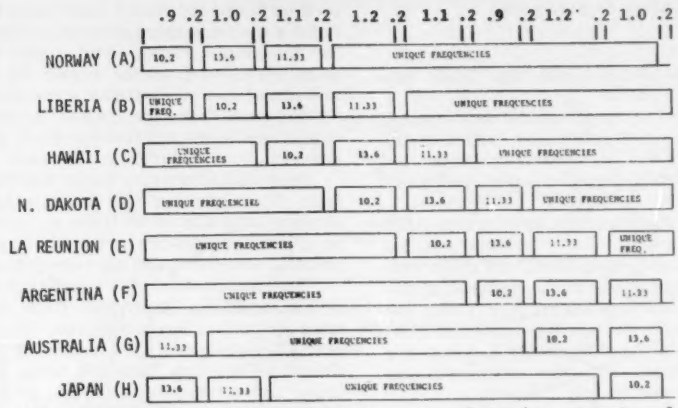
The idea for a phase difference rather than a pulse time difference navigation system was first proposed in 1947. Initial experiments were made with broadcast frequencies of about 50 kHz (LF), but the idea's true potential became apparent through later work with the 10 kHz (VLF) range. At one time or another, broadcasts were tried from the States of New York, California, and Hawaii, as well as from the Canal Zone, Wales, Norway, and Trinidad. The U.S. Navy, which was administering the Omega Project, subsequently kept four of these temporary facilities on the air for long-term experimentation and development.

Not only were the results successful, but numerous countries held cooperative tests with the United States, and were conducting their own research in receiver development and applications for the system. As a result, international interest was high when it came time for transmitter site selection, and when the final choices were made based on the best geographical distribution, the countries solicited offered enthusiastic support. Ideally, six stations could have provided worldwide coverage, but one would have had to be located at each pole, with the remaining four at 90° intervals around the Equator. The eight sites selected were the most practical compromise.

Omega transmitters will be far enough apart that while the system is hyperbolic--that is, the radio waves spread out from the transmitter in the shape of a hyperbola--the LOPs will be straight lines for most smaller-area plotting purposes. Position accuracy

Table 2

OMEGA SIGNAL FORMAT



The ten-second pattern of frequency pulses is structured in order that no two stations broadcast the same frequency at the same time. Each station also has certain unique frequencies that may be used for such things as time dissemination.

of about 1 mi can be expected, although propagation variations will require use of certain correction tables.

To enable such accuracy, the transmitters themselves must be extremely effective. Where mountainous terrain requires it, antennae are being strung across valleys, though in the case of La Reunion this poses a special problem. A river runs across the valley floor, and steep, rocky walls line both sides, making proper antenna grounding difficult. One early plan called for 200 acres of copper wire mesh to be installed under the antenna spans, however the valley span antenna proposal was eventually replaced by a tower antenna plan. Construction is reportedly proceeding slowly, since the crew must contend periodically with winds topping hurricane force.

Each station will broadcast (table 2) a 10-sec cycle, consisting of a sequence of 10.2 kHz, 13.6 kHz, 11.33 kHz pulses followed by a period of a frequency unique to that station, in such a way that no two stations will be broadcasting the same frequency simultaneously. With VLF's low attenuation and long-range propagation, reception should ordinarily not be a problem. And, through international cooperation, mariners will have come another long step from the ancient days when ships navigated by sailing to their destination's latitude, then running east or west hoping to find it.

NOAA SHIPS SCOUR BOTTOM OF AMERICA'S COASTAL WATERS

Two unique NOAA vessels have spent the past 4 mo searching the bottom of the sea off the coast of the Gulf of Mexico. They found no treasure, only more evidence that coastal waters have become the dumping ground for unwanted material. They found also that some of the debris which clutters the bottom is becoming increasingly a hazard to shipping as vessels with deeper drafts are being constructed and the amount of water required for safe passage is constantly increasing. A little more than a half century ago Survey vessels were wire dragging for depth clearances of 20 to 25 ft, then considered adequate for safe passage.

The 90-ft, 200-ton sister ships, RUDE and HECK, are ocean wire drag vessels and are the nation's only craft devoted solely to searching ofr submerged obstructions which may be dangerous to shipping. They drag a one-quarter-inch steel wire between them at distances up to 2 mi to locate wrecks, shoals, reefs, and other underwater hazards. Information concerning those regarded as navigational hazards appears on the nautical charts issued by NOAA's National Ocean Survey, which operates the NOAA Fleet.

The wire drag ships determined the precise position, and the depth of the water above them, of several wrecked ships for which only the general location had been previously known. Their search also brought to light an oil "Christmas tree," a device used to cap an underwater oil well; a steel tank; a sea buoy; seven ship's anchors; various pipes; a concrete block measuring 3 by 4 by 4 ft; a vertical "I" beam; a survey platform, presumably the floor of an oil rig, a temporary structure from which oil exploration is carried on; a survey tower, the rigging above the platform; another tower; a ship's steel hull; a steel cylinder; and sundry other objects described by the ships' commanding officer as metal objects, steel obstructions, and a pile of "junk" 4 ft high.

The obstructions reported by the ships were found in water 36 to 68 ft deep. Some were patently dangerous for vessels with a deep draft, like the metal object off Mobile Bay which lay in 63 ft of water, but rose to within 26 ft of the surface; the survey tower in Sabine Pass, Tex., which was covered by only 30 ft of water; and the steel hull of a vessel which apparently sank years ago off Horn Island, Miss., in 45 ft of water. This remnant of a wrecked ship rose above the bottom to within 34 ft of the surface. And the Gracie L., a fishing vessel which reposed in 60 ft of

water off the Mississippi coast, had only 23 ft of water above its highest point. The pipe had a clearance of only 14 1/2 ft. All these obstructions were found in shipping channels leading to Gulf ports.

MARAD USING NASA SATELLITE TO TEST ADVANCED COMMUNICATIONS

As part of its continuing research and development program, the Maritime Administration will test advanced communications and navigation equipment and techniques on commercial vessels using the NASA "Applications Technology Satellite-F" (ATS-F).

MARAD will share satellite time with various other Federal and State agencies. Two merchant vessels will be equipped with relay terminals, and the Maritime Coordination Center (MCC) at the National Maritime Research Center at Kings Point, N.Y., will develop operating procedures and management techniques for use of a special radio band (two-way L-band) for maritime communications. The new equipment was scheduled to be operational in July.

Prior to this, 125 other experiments were conducted involving nine ships, During these tests, more than 5,000 messages, 2,000 of which were ship-to-shore transmissions, were transmitted via satellite between ships in the Atlantic and Pacific Oceans and the Maritime Coordination Center at Kings Point. Broadcast-type messages to all ships, as well as private messages involving particular ships, were transmitted. The tests also demonstrated the potential of the Maritime Satellite, Communications, and Navigation (MARSCAN) system to determine ship positions.

LONG SEARCH PAYS OFF

Climaxing nearly 11 days of a multiservice search for the missing fishing vessel, CARRI ANNE, an HU-16 from the San Francisco Air Station located it about 70 mi west of Santa Barbara.

The 35-ft craft, with three persons on board, was the subject of a search that began on the evening of July 26. The search began when a radio message received at Coast Guard Group Monterey said the craft was suffering engine failure and needed assistance. Coast Guard, Air Force, and Navy aircraft, in addition to Coast Guard surface vessels, participated in the search from that time until the CARRI ANNE was located on the afternoon of August 5.

Upon locating the CARRI ANNE the Coast Guard aircraft dropped food, water, and a radio marker beacon to them, all of which were retrieved by the men on board the craft. A short time later all aboard were reported to be in good condition.

The HU-16 aircraft remained on the scene, keeping the vessel in view until it was relieved by a C-130, also from San Francisco, which kept the vessel in sight until the arrival of the Coast Guard Cutter RESOLUTE the following morning. The cutter then took the fishing vessel in tow to Morro Bay Harbor.

As is traditional with men of the sea, the skipper of the CARRI ANNE remained on board, along with a crewman from the RESOLUTE. The two crewmembers of the CARRI ANNE, however, chose to go aboard the RESOLUTE for the journey to shore.

The fishing vessel had departed San Diego on July 23, enroute to Portland, Oreg., and later encountered engine failure somewhere off the California coast. Until the vessel was spotted by the Coast Guard aircraft her position had never been firmly established.

After giving up attempts to restart her engine, the men on board the vessel used parts from the engine to build a hand-operated generator which provided power for the ship's radio. Still, only broken messages were received from the vessel by the Coast Guard, and direct communications were never established.

The men from the CARRI ANNE later said they caught sea birds and fish for food, and built a still to convert ocean water to freshwater.

Poor visibility was a major hindrance to the search from its beginning, with ceilings as low as 50 ft and surface visibility of as little as one-tenth mile. Atmospheric conditions gradually improved during the search, however, and the vessel was located.

The combined service search efforts for the CARRI ANNE included: 73 aircraft flight missions by fixed-wing aircraft of the Air Force, Navy, and San Francisco Coast Guard Air Station, in addition to Coast Guard helicopters from the Long Beach/San Diego area; the cutters RESOLUTE, CAPE WASH, POINT WINSLOW, from the 12th District, headquartered in San Francisco, and the POINT JUDITH from the 11th District, with headquarters in Long Beach. The total area covered in the search included some 235,000 sq mi.

NEW MAPS SHOW N.Y.-N.J. STORM EVACUATION ROUTES

Storm evacuation maps have been published for a 150-mi stretch of New York-New Jersey coastal areas, including Elizabeth, Newark, Jersey City, New York, and all of Long Island. The small-scale maps are designed to facilitate evacuation of people from endangered areas.

Six maps (fig. 17) have been released by NOAA's National Ocean Survey covering an area from Manasquan Inlet, N.J., inland to about 15 mi from (but not including) Trenton, N.J.; then north up the coast through Elizabeth, Newark, Jersey City, and New York; then east across the length of Long Island to Montauk Point. The maps cover all, or parts, of the following counties: New York -- Suffolk, Nassau, Kings, Queens, Richmond, New York, Westchester; New Jersey-- Union, Passaic, Bergen, Essex, Monmouth, Middlesex, Ocean, Hudson. Each map covers an area of approximately 24-by-30 statute miles.

The maps show emergency evacuation routes, areas subject to flooding from hurricanes and other storms, and elevations which might afford "safety islands" for storm evacuees. The maps will be distributed to state and local officials and community emergency preparedness committees by NOAA's National Weather Service. Maps may be purchased by the public for $2 each from the National Ocean Survey Distribution Division (C44), Riverdale, Md. 20840.

Storms, particularly hurricanes, on the Atlantic coast and in the Gulf of Mexico at times cause extensive flooding of low-lying coastal regions. The National Weather Service maintains a close watch on the storms, predicting the height of the storm surge and issuing emergency warnings for areas which might be subjected to flooding. Contours on the maps provide a means of estimating areas of possible flooding. The maps also include delineation of the main evacuation

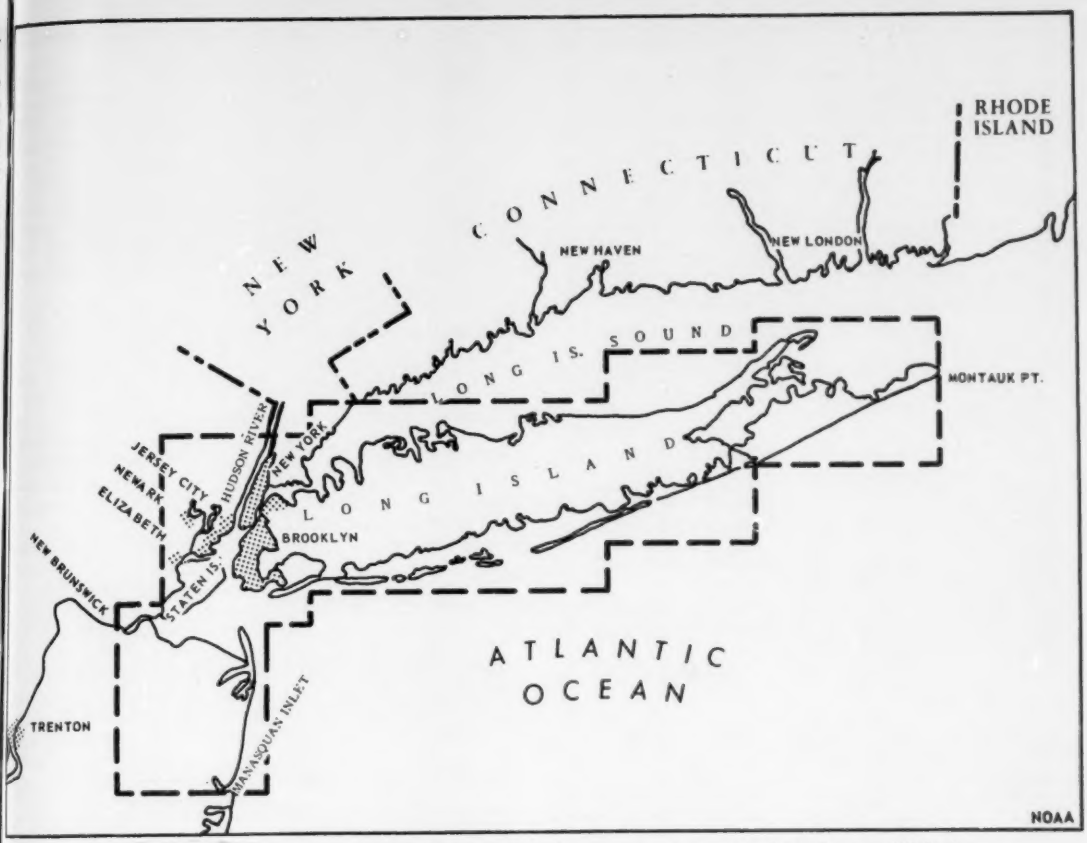


Figure 17. --New Jersey-New York area for which storm evacuation maps have been published.

routes and feeder roads; low points along the roads that might be engulfed; and high spots which are likely to remain above the flood waters, thus affording some degree of refuge. Critical elevations are spaced on the maps at intervals of 2 mi or less.

The New York - New Jersey maps show areas subject to flooding in increments of 10 ft, in distinctive color tones. Both surfaced and unsurfaced evacuation roads are identified, along with county, state, and federal designations and the number of lanes for each road. Urban populations, as well as season and off-season population figures for resort areas are shown to facilitate evacuation planning. Railroads that might offer avenues of escape are also shown.

The maps are printed at a scale of approximately one mile to the inch. Details are sufficiently clear so that they can be reproduced by mass communications media, including newspapers and television stations.

Storm evacuation maps are also available for three Gulf Coast areas--five for New Orleans, La., to Mobile, Ala., six for Galveston to Houston, Tex., and four for the Corpus Christi, Tex. area. In addition, six maps have been published for the coastal corridor from Charleston, S. C., to Savannah, Ga.; and four maps for the Norfolk, Va., Tidewater Area.

TIME AND FREQUENCY STATIONS WWV AND WWVH WEATHER BROADCAST SCHEDULES CHANGED

As of November 1, 1974, the storm information broadcasts by the National Bureau of Standards Time and Frequency Radio Stations WWV, Fort Collins, Colo., and WWVH, Kekaha, Hawaii, changed as follows:

Radio WWV

H+08 and H+09: Western North Atlantic, including Gulf of Mexico and Caribbean Sea.

H+10: North Pacific east of 140°W.

Radio WWVH

H+48, H+49, and H+50: North Pacific; also South Pacific, Equator - 25°S, 160°E - 110°W.

U. S. HAS 561 MERCHANT SHIPS

The active privately-owned sector of the U.S. merchant marine consists of 561 oceangoing ships, comprising 13,200,000 deadweight tons, according to the U.S. Department of Commerce. Currently, the active American ocean fleet includes 170 freighters, 229

tankers, 21 bulk carriers, 136 intermodal ships, and 5 combination passenger-cargo ships.

In addition, the Great Lakes fleet on August 1 was comprised of 198 self-propelled American-flag vessels aggregating about 2,600,000 deadweight tons.

As of August 1, 96 merchant ships totaling more than 7,900,000 deadweight tons were under construction or on order from American shipyards. Valued at over $4.2 billion, the shipbuilding order book includes 75 tankers, 11 intermodal carriers, 7 dry bulk carriers, and 3 special-type vessels.

HIGH WATER LEVELS IN GREAT LAKES CONTINUE FOR THIRD SEASON

The Great Lakes are currently well into their third season of high water levels, a condition which has occurred only twice before in this century, and scientists are making no predictions when this condition will abate. The outlook for next year is for continued high lake levels. The Lake Survey Center said high water levels such as these usually persist for only about 2 yr, but forecasters give little promise that the rate of precipitation will slacken in the near future.

Lakes Erie and St. Clair have already broken the record high level of water they set last year in May. While both were below their monthly record highs for the summer, they may again approach record highs this fall. The rest of the Great Lakes are expected to continue well above their long-time averages, although they are not expected to break established records.

Similar conditions this century occurred in 1917-18 and 1952-53. NOAA scientists say that when the weather settles into its usual pattern and the amount of precipitation returns to normal, the water levels will go down in the Great Lakes. The lake level forecast, however, calls for continued high levels through December, with the lake levels at the end of the year being within a few inches of those of last December.

The amount of precipitation and evaporation largely determines lake levels. Great Lakes precipitation averages about 31 in/yr. Precipitation over the Great Lakes can be staggering in its statistics. One inch of rainfall, for example, on the city of Detroit will amount to approximately 2.4 billion gallons. Evaporation from the surface of the lakes varies from about 18 in/yr on Lake Superior to 35 in/yr on Lake Erie, the actual amount dependent on varying factors, including the weather, the condition of the land, and the seasons.

The present high lake levels are primarily due to precipitation (both rain and snow) which has been 16 1/2 in above normal since 1965. This condition has been aggravated by below-normal evaporation, and the cumulative effect has been to raise lake levels in some cases to all-time highs.

Because of their huge size and storage capacity and relatively small outlets, the Great Lakes do not respond quickly to changes in supply. Once the lakes are high, the small outlets restrict the flow and the levels remain high, even when the supply decreases. The Great Lakes contain the world's largest supply of freshwater, nearly 5,500 cu mi, enough to cover the entire continental United States to a depth of over 9 ft. Their water area stretches nearly 100,000 sq mi, about equal to the combined land area of Michigan, South Carolina, and Massachusetts.

IRONCLAD MONITOR NATION'S FIRST "MARINE SANCTUARY"

The remains of one of the nation's most historic warships, the ironclad USS MONITOR, and the ocean area where it has rested for more than 100 yr have been nominated to become the country's first Marine Sanctuary. North Carolina Governor James E. Holshouser, Jr. made the nomination. The MONITOR rests 220 ft beneath the surface of the ocean some 16 mi off Cape Hatteras, N.C. Designation of the wreck site as a Marine Sanctuary will help to ensure that the MONITOR is safeguarded and that archaeological research will be controlled.

In nominating the MONITOR and its site as a Marine Research Sanctuary, both the historic and technological value of the Civil War gunboat was cited. The MONITOR is best known for its celebrated encounter with the Confederate ironclad ram, CSS VIRGINIA, popularly known as the MERRIMAC. To ship builders, however, the MONITOR represents a revolutionary concept in 19th century naval technology, symbolizing both the end of the wooden, sail-powered fighting ships and the beginning of the development of the modern capital ship.

The MONITOR foundered during a gale off Cape Hatteras on the last day of December, 1862, and sank with 16 of her crew onto treacherous Diamond Shoals. There the 172-ft warship rested, upside down and uncharted, for almost 111 yr until the summer of 1973 when the wreckage was discovered by a marine research team using sonar and underwater photography techniques. Early this year, a more elaborately equipped scientific expedition operating aboard the ALCOA SEAPROBE confirmed the earlier find, obtaining hundreds of photographs of the wreckage and eliminating all doubt that it was, indeed, the MONITOR.

WAVE STUDIES

Scientists have made a topographic survey of the ocean west of Dakar, Senegal, to determine how the surface texture of the sea affects the exchanges of energy and momentum between the ocean and atmosphere -- exchanges that are fundamentally linked to world weather. The wave investigation was part of the third phase of GATE, the Atlantic Tropical Experiment of the United Nations' Global Atmospheric Research Program, sponsored by the World Meteorological Organization and the International Council of Scientific Unions.

The phenomena of greatest interest were waves with lengths ranging from 1 to 500 m--the high-frequency surface events of the sea, from light choppiness to swells. The frequency distribution of waves in this range is known to be important to mixing processes in the upper few hundred meters of the ocean, but the details of this relationship are not well understood. Nor are the links between events in the mixing layer and the ocean's ability to yield up heat energy to the atmosphere.

The wave experiment combined sensors aboard aircraft and an array of ship-launched buoys to obtain a uniquely detailed view of the surface structure of the tropical Atlantic Ocean. In addition to the measurements needed by GATE, the wave study was used to help test the U.S. Navy's ocean-forecasting computer models.

To obtain these measurements, GATE brought together an international assortment of ship-launched buoys and laser-bearing aircraft. Six ships participated in the wave buoy experiment--Canada's QUADRA, the Federal Republic of Germany ship METEOR, the University of Miami's GILLIS, the Texas A&M University ship FAY, and the OCEANOGRAPHER and RESEARCHER, both from the National Oceanic and Atmospheric Administration. In addition, four Soviet ships--the ACADEMICIAN KURCHATOV, PRIBOY, PROFESSOR ZUBOV, and ACADEMICIAN KOROLOV--took data with hull-mounted wave sensors.

Each of the buoy ships launched two floating systems designed to measure different aspects of ocean wave motion. A British-developed pitch and roll buoy, shaped like an open cone about 4 ft across the base, senses the frequency and direction of wave action. The Dutch-developed wave-rider buoy is a moored sphere 3 ft in diameter, designed to measure the up and down motions of waves passing its station. The pitch-roll buoys are tethered to their ship, and pass data along an electrical line running along the tether. The wave-riders relay their data to the ships by radio telemetry.

Two aircraft--a Navy P3A from the Naval Oceanographic Office and a DC-6 from NOAA's Research Flight Facility in Miami--made daily runs near the area occupied by the ships and buoys, profiling the ocean surface with a laser device from altitudes of 300 to 500 ft. Developed to measure land elevations for airborne topographic surveys, the laser profilometer has been adapted by oceanographers to measure precise wave heights from an airplane. This airborne study is the first of its kind.

Waves are an important part of the world weather problem, but just how they fit into the problem has never been studied in any systematic way. This investigation should produce specific quantities to use in determining how waves are related to the processes which move energy and momentum from the ocean into the atmosphere. It should also help develop models which specify conditions--including wave conditions--in the oceanic boundary layer, and permit tests of some of the advanced wave-forecasting models the Navy has under development.

NOAA BUYS TWO FLYING LABORATORIES FOR RESEARCH, WEATHER MODIFICATION

NOAA is purchasing two new Lockheed WP-3D "Orion" aircraft (fig. 18). The acquisition marks the first time the Commerce agency has purchased a new airplane built from the production line up for the special needs of atmospheric and oceanic airborne research. The aircraft will be operated by the Laboratories' Research Flight Facility in Miami, Fla.

These new aircraft will be uniquely suited to the difficult work they will be doing. They will carry the world's most advanced airborne research data systems, and have the strength and stamina to support NOAA's environmental mission anywhere in the world. They will eventually replace three older research aircraft, which provide support for such activities as hurricane experiments, winter storm surveillance, satellite-sensor development, and a variety of atmospheric research projects.

Cost of each aircraft will be about $7 million, with research instrumentation bringing total cost to about $10 million each before the flying laboratories are operational. The first P-3D is scheduled for delivery in May 1975, the second, in January 1976. Instrumentation will be installed by the summer of 1976, when the airplanes will begin Project Stormfury, the agency's hurricane-modification experiment. There is evidence that cloud-seeding experiments of the type used in Project Stormfury can reduce hurricane winds, and perhaps mitigate these storms' destructive effects.

The P-3D is the most recent descendant of a design familiar to most air travelers as the turboprop "Electra," although the resemblance is only skin-deep--the Orion series is a tougher, more powerful airplane than its civilian ancestor, developed to carry out the U.S. Navy's antisubmarine warfare and weather reconnaissance missions. The Orion is powered by four Allison turboprop T-56-A-14 engines, each rated at 4,910 equivalent shaft horsepower. It can operate effectively from sea level to 30,000 ft (9,100 m), loiter at speeds between 180 and 225 kt (355 and 415 km/hr), and attain dash speeds in excess of 400 kt (740 km/hr).

The aircraft will have a maximum range (with a 12,000-lb, or 4,500-kg, payload) of more than 4,200 mi (7,800 km), with a 2-hr fuel reserve based on four-engine operation. It will be capable of loitering in a target area 650 mi (1,200 km) from base for 10 hr at 28,000-ft (8,500-m) altitude, with a 2-hr fuel reserve remaining upon return to base. The airplane will also be able to accomplish the same mission with loiter for 8 hr at 5,000 ft (1,500 m) and will be able to operate for 10 hr at 1,500 ft (460 m).

The principal visible difference between the NOAA craft and their Navy cousins is two additional bubble windows in the fuselage, an additional scientist-station window aft of the pilot's station, and wing fittings for external instrumentation and seeding-agent stores. The aircraft mounts a C-band radar in a large blister radome just aft of the nosewheel well, a weather radar in the nose radome, and an X-band radar in a special tail radome.

It will carry a flight crew of four--pilot, co-pilot, flight engineer, and navigation-communication operator--and a mission crew of 12 scientists, technicians, and observers. Seats will also be provided for five passengers.

Figure 18.--The new Orion which will be used for environmental research and weather modification.

NEARLY 1,400 BERGS MENACED SHIPPING IN '74

Nearly 1,400 icebergs drifted into the Grand Banks off Newfoundland to menace Atlantic shipping between March and August (cover picture). This was the second highest number of icebergs to drop below the 48th parallel since the International Ice Patrol began tracking them shortly after the passenger liner TITANIC struck an iceberg and sank in 1912. Although the iceberg count was high this year, a series of strong southwesterly winds pushed many bergs into eastward flowing currents to keep them from cutting too deeply into the shipping routes.

Less than 300 icebergs made it as far south as the 46th parallel before melting. Once icebergs move below the 48th parallel they begin to melt in the warmer water. Their life expectancy can be a few days or a couple of weeks. The most southern iceberg this season reached the 42d parallel, putting it about 900 mi east of Cape Cod, Mass.

Coast Guard aircraft make three to four ice reconnaissance flights a week during the season. The information from these patrols (fig. 19), along with iceberg sightings reported by ships and other aircraft, are passed to Ice Patrol headquarters. These data are fed into a computer along with ocean current and weather information. Each 12 hr the predicted locations of the icebergs are broadcast from radio stations in the United States, Canada, and Europe.

This year the bergs were clustered in groups of 20 to 40, making them easier for aircraft to track and ships to avoid. This was not the case the past 2 yr. An unequalled record of 1,587 icebergs crossed into the Grand Banks in 1972, and last year 847 bergs were detected. During the peak of those seasons the bergs were spread over 190,000 sq mi and "surface patrols" by Coast Guard cutters were necessary to warn shipping away from the southernmost ones. Only twice in the past 15 yr has it been necessary to use patrol vessels.

Although no surveillance vessels were used this season, one cutter did take part in ice patrol operations. The Coast Guard's oceanographic ship EVERGREEN conducted research among the North Atlantic icebergs. Researchers aboard carried on studies of ocean currents and their properties to determine their effects upon the drift and deterioration of the icebergs. This information was computer processed on board and transmitted to Ice Patrol headquarters for use in forecasting iceberg locations.

The seasonal average of icebergs below the 48th parallel is less than 300. Over the past 3 yr the iceberg migration has been well above average. The four seasons before 1972 were below-normal years for icebergs. An estimated 10,000 bergs break off the West Greenland glaciers each year. How many of them reach the North Atlantic waters after a 24-mo, 1,800-mi journey depends upon weather and oceanographic variables. These conditions make long-range predictions extremely difficult.

Figure 19. --An ice patrol aircraft locates and tracks an iceberg off the Grand Banks.

LETTERS TO THE EDITOR

SAILING VESSEL TINA ENCOUNTERS HIGH WAVES

The following correspondence was exchanged with Francis W. Sheild of Hampton, Va. He and a crew of five were sailing from Bermuda to Long Island the first week of July, 1974, on the 38-ft sailing vessel TINA.

From Dr. Sheild:

"I am writing to report an unusual circumstance encountered by the 38-ft sailing vessel TINA in 36.5°N, 68.5°W from 2000 DST, 4 July (0000 GMT, 5 July) to 0700 DST, 5 July (1100 GMT).

"We encountered clear skies and full moonlight with 17- to 20-kt winds from the northwest (relative to the boat 345° at 6 kt). A big sea got up about dark forcing us to run off and trail warps about midnight. We put the helm down to the lee and tacked a storm jib lead to just inside the weather shrouds so she sailed herself nicely dead downwind 090° to 110° magnetic at 1 1/2 to 2 kt all night. The least sea was above our spreaders and the largest above our mast. TINA is a 38-ft steel sloop and I would judge the seas 30 to 38 ft conservatively. The tops were vertical and didn't break until the wind got over 20 kt. I was too busy to get the period (forgot) but they were steep and so very close together we had to run off at speed to give TINA time to recover and rise to the next one. I have never before seen seas higher than the wind velocity. Hope this is a help."

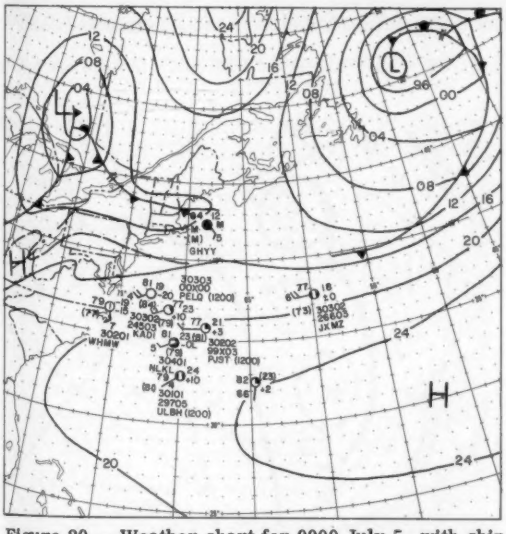


Figure 20.--Weather chart for 0000 July 5, with ship data plotted for that hour and 1200 (indicated by [1200]). The last two digits of the five digit groups indicate sea and swell heights in half meters. The sea group begins with the digit 3.

To Dr. Sheild:

"Thank you for your letter concerning your experience, on July 4-5, on the sailing vessel TINA.

"My weather maps for 0000 (fig. 20) and 1200 July 5, 1974 do not indicate any type of severe weather system in the area. The two closest LOWs are northeast of Newfoundland and north of Lake Huron. An elongated Bermuda-Azores HIGH was south and east of your position. The sea-level pressure in the area where you were located should have been about 1021 mb.

"Ship reports and satellite pictures show the clear to scattered clouds you referred to. The two ship reports closest to your position were at 1200 GMT on the 5th and were the GULF HOLLANDER and ROTTERDAM. They reported scattered clouds, 10- and 15-kt winds, and 3- and 5-ft waves. The highest waves reported within 500 mi were 8-ft swells at 1200 on the 5th by the KRASNOZAVODSK near 33°N, 70°W. The data is sparse and we realize there are meso-systems that go undetected.

"There is one possible explanation that may have a bearing on the high waves you describe. This deals with winds blowing in the opposite direction to currents and setting up higher than normal waves. I contacted a gentleman who is working on this and he said there was a cold-water eddy in the Gulf Stream near your position. I am expecting an article on this in the near future." (See article by R. W. James, page 363 of this issue.)

From Dr. Sheild:

"Thank you for your kindness in answering my letter in such detail. I am sure the waves we experienced on TINA did not come from any weather system as we left Bermuda 1 July 74 with a good 5-day prognosis and got good enroute weather from Bermuda Harbor Radio, WOM Miami, Fla., WOO Ocean Gate, N. J., Coast Guard Boston, Mass., and FAA Weather from New York Radio at JFK Airport. Our barometer ranged from 1024/26 mb at Bermuda to 1019/20 mb at Montauk and was about 1022 mb the 4th as best I remember. We sailed about 320° to 350° magnetic about 50° to 60° off the wind on port tack as the wind lifted and headed us, and let her run free a bit to foot along, figuring to get up to the coast as soon as possible, and tack for westing if we needed it on the home stretch. Wind velocities the 4th were about 15 to 17 kt across the deck. I will check this on the ship's log but indeed the waves didn't come from the weather. All day the 4th we slapped badly into a 4- to 6-ft chop quartering on the bow with a lot of whitecaps which were not too big. I thought at the time it looked like a 1- to 1 1/2-kt current against the wind and allowed a 6- or 8-mi set to the west for the day's run (to be offset mostly by the boat's leeway). Then about 1830 DST (2230 GMT) the chop from the northwest stopped and we got a 6- to 8-ft swell on the beam from about the west-southwest and rode quite comfortably, had a hot supper thank goodness, and the winds were about 15 kt over the deck. About 8 p.m. (0000 GMT) the sea started building, up to the spreaders by 1030 (0230 GMT) with the wind about 18 kt, and we began to shorten sail to control our speed as we shifted our course to quarter into them. It was very much a building sea with steep slopes and 6 or 8 ft of unstable water at the tops. The worst of it was that they were so close to-

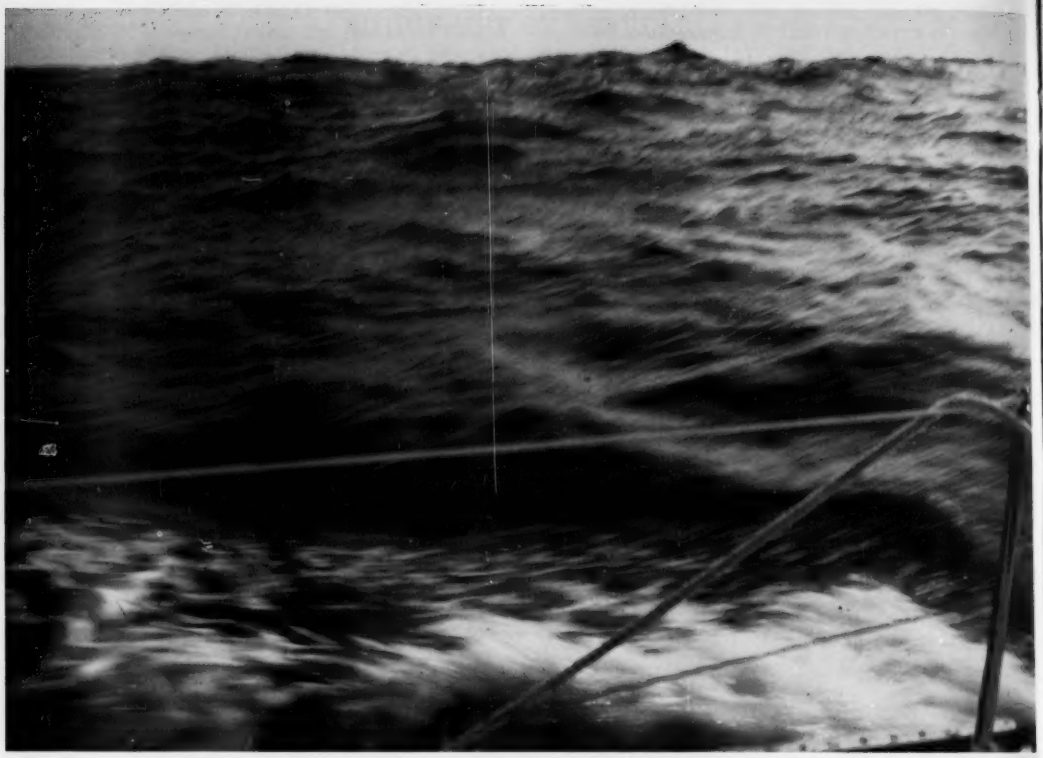


Figure 21. --Building swells on the evening of July 4. Unfortunately the larger waves were encountered that night and could not be photographed.

gether we had our greatest trouble in the troughs to keep from shovelling up the next while coming off the back of the one just behind. Wind velocities were still about 20 kt over the deck. By 0130 (0530 GMT), we had run off before the sea (all well over 30 ft, occasional seas to masthead) with the storm jib just inside the weather stays, helm lashed to lee, and warps trailed astern to cut the speed down to 2 kt. This way she rode nicely and things were very benign for awhile. About 0230 (0630 GMT) the wind finally rose up to 27 kt and caused breaking of some unstable water at the tops, one of which pooped us but caused no problem. About 0430 (0830 GMT) we noticed a cross sea, the big waves were gone, and we made off about 0530 (0930 GMT) with about 20-ft swell from the northwest and winds about 18 kt. There was an easy sea by lunch.

"Enclosed are slides of the 6- to 8-ft swell the night of the 4th and the larger 20-ft swell the morning of the 5th. These are culls as I sent the better ones off for copies, but will send you a couple along with a slide of a waterspout that passed a few hundred yards astern a couple of days earlier. Winds then were under 10 kt and swell less than 1 ft with small rain showers and 4 to 6 waterspouts around on the horizon. We were then about 30 mi northwest of Bermuda.

"For a crew we had a mortgage broker who had been on destroyers and Vietnam "fast boats" in the Navy, an ex-Navy pilot, a fellow who works for West-

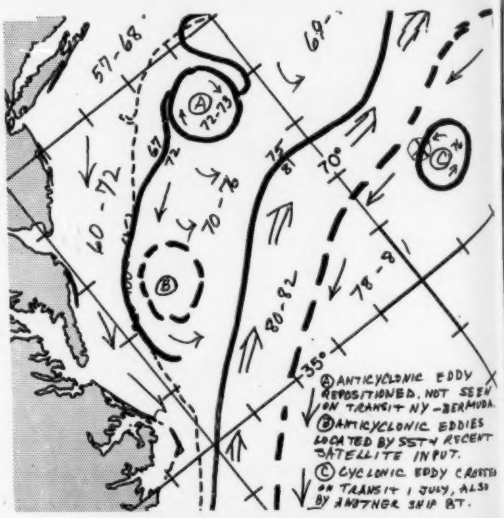


Figure 22. --U.S. Naval Oceanographic Office Experimental Ocean Frontal Analysis for July 3, 1974. The position of the TINA is indicated by the + in the cold eddy centered near 3u°N, 68°W.

inghouse Oceanic Division, a book salesman, and an FBI agent. Three of us had ocean sailing backgrounds, three had big ship backgrounds. All of us came away very impressed. There was not one of us who cared for another experience such as that, although it was only unpleasant after we got TINA dressed out to manage herself, not awful.

"Thank you again for your letter. It was a strange experience, short and sobering, but not being able to account for it bothers me the most.

"The slides were all taken with a 28-mm (wide angle) lens which is like looking at waves through the wrong end of binoculars. They don't prove much as they were before and after pictures when we were sailing along under comfortable control, but they do in a way, document the building and declining swell at the time. They were taken at the tops.

"Again, thanks for your letter. I would enjoy hearing any followup you may have."

Editor's Note: The Gulf Stream Analysis, for July 3, 1974, prepared by the U.S. Naval Oceanographic Office, indicates a cold core cyclonic eddy (fig. 22) centered near 35.2°N, 68.2°W. The position given for the TINA was about 80 mi northwest of this center on the faster edge of the circulation. The temperature contrast across the eddy was not great, only about 5°F. A current speed in the area of 1 or 2 kt was estimated. Using the information and graphs from Dr. James' article and the information from various ships close by, I still cannot account for the high waves reported. Like many things that occur in the vast oceans of air and water, this is another that cannot be explained with the data available.

MARINE WEATHER REVIEW

U.S. Ocean Buoy Climatological Data Summary

Table 3

A summary of the available climatological data for ocean buoys, prepared by the National Climatic Center, are shown below. The period of record, which varies, is indicated for each buoy. Monthly buoy climatological data will replace the Ocean Station Vessel data in the January 1975 issue, except for Ocean Station "Hotel."

AREA: EB01 POR: 1972 - 1974 36.5°N, 73.5°W	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SEA LEVEL PRESSURE (MB)												
5% ≤	1006.5	996.2	995.2	995.4				1011.6	1008.7	1001.2	1002.3	1002.2
MEDIAN	1018.3	1015.3	1014.3	1009.1				1018.8	1018.7	1019.4	1018.1	1019.1
95% ≤	1027.9	1028.7	1029.6	1027.8				1022.3	1027.2	1031.6	1026.5	1031.2
NUMBER OF OBS	684	251	513	245				217	237	786	1161	935
AIR TEMPERATURE (DEGREES F)												
5% ≤	37.6	37.9	45.7	50.5				75.0	72.0	56.1	46.9	41.5
25% ≤	45.9	47.3	52.0	57.7				77.5	74.7	61.9	53.4	54.3
MEDIAN	53.6	53.2	60.4	63.1				79.3	76.8	67.5	61.5	59.9
75% ≤	61.3	58.5	65.3	66.0				80.8	79.3	71.1	66.7	67.8
95% ≤	68.2	63.9	72.0	70.0				82.8	82.4	75.0	71.6	73.2
NUMBER OF OBS	685	254	513	245				217	238	786	1161	936
SEA SURFACE TEMPERATURE (DEGREES F)												
5% ≤	54.7	60.8	69.6	64.9				77.2	72.9	68.2	60.4	58.8
MEDIAN	68.5	71.4	72.7	69.1				78.8	80.8	73.0	70.2	71.1
95% ≤	74.3	74.3	74.8	73.6				81.7	82.0	79.7	76.6	77.4
NUMBER OF OBS	743	340	351	209				244	236	786	1162	985
MEAN RELATIVE HUMIDITY (%)	76	81	76	73				83	77	73	74	78
NUMBER OF OBS	683	223	512	245				217	236	786	1161	935
WIND SPEED (KNOTS)												
% FREQUENCY ≥ 34 KNOTS	2.1	7.4	11.3	2.4				.0	.0	1.2	1.9	4.6
5% ≤	5.0	4.8	4.0	4.0				2.0	2.0	4.0	5.0	6.0
MEDIAN	19.0	21.0	21.0	19.0				10.0	9.0	15.0	17.0	19.0
95% ≤	30.0	37.0	38.0	32.0				21.0	20.3	30.0	30.0	33.0
NUMBER OF OBS	682	136	513	245				226	234	761	1089	936

AREA: EB02 POR: 1973 - 1973 27.5°N, 88.0°W	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SEA LEVEL PRESSURE (MB)												
5% ≤			1006.1		1010.0	1014.0	1014.3	1012.5	1009.6			
MEDIAN			1017.4		1017.2	1018.1	1016.9	1016.3	1014.6			
95% ≤			1019.4		1022.2	1021.0	1021.1	1019.0	1019.0			
NUMBER OF OBS			72		311	198	73	209	195			
AIR TEMPERATURE (DEGREES F)												
5% ≤			59.7		70.7	78.6	81.5	81.0	79.0			
25% ≤			65.3		72.3	80.2	82.6	82.2	81.3			
MEDIAN			67.5		74.8	81.9	83.3	83.1	82.0			
75% ≤			70.7		77.5	83.3	84.7	84.6	82.9			
95% ≤			72.1		80.4	85.3	85.6	86.2	84.4			
NUMBER OF OBS			72		312	188	73	211	183			
SEA SURFACE TEMPERATURE (DEGREES F)												
5% ≤			66.9					76.8	80.2			
MEDIAN			70.3					82.0	82.8			
95% ≤			70.7					83.7	83.5			
NUMBER OF OBS			70					89	178			
MEAN RELATIVE HUMIDITY (%)			79		76	78	77	76	83			
NUMBER OF OBS			72		311	187	73	197	178			
WIND SPEED (KNOTS)												
% FREQUENCY ≥ 34 KNOTS			.0		.0	.0						
5% ≤			7.7		2.0	1.0						
MEDIAN			16.0		9.0	7.0						
95% ≤			26.5		18.7	14.0						
NUMBER OF OBS			71		306	103						

AREA: EB03 POR: 1972 - 1974	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
58.8°N, 147.8°W												
SEA LEVEL PRESSURE (MB)												
5% ≤	969.7	985.3	990.4	989.5	990.4	994.0			1003.4	987.5	984.7	977.1
MEDIAN	1010.3	1003.5	1003.7	1001.3	1005.8	1013.3			1021.4	1010.2	1004.2	1006.8
95% ≤	1044.9	1029.3	1017.8	1019.7	1027.0	1020.5			1025.6	1027.1	1019.4	1043.1
NUMBER OF OBS	249	761	538	169	412	213			109	983	908	701
AIR TEMPERATURE (DEGREES F)												
5% ≤	25.5	26.4	29.3	34.9	37.4	42.1			48.2	37.0	35.2	30.4
25% ≤	29.3	33.8	33.1	36.0	38.7	43.3			49.3	43.0	39.6	35.8
MEDIAN	33.8	35.8	34.3	37.0	40.1	44.8			50.2	44.6	41.2	38.1
75% ≤	37.0	37.2	36.1	38.8	41.7	46.9			50.7	46.2	42.6	39.4
95% ≤	38.7	38.7	37.8	40.8	43.7	49.8			51.4	47.8	44.1	41.7
NUMBER OF OBS	249	591	398	168	412	214			136	983	908	688
SEA SURFACE TEMPERATURE (DEGREES F)												
5% ≤		37.2	37.2	39.2	39.6				50.9	44.2	40.8	40.6
MEDIAN		37.6	37.6	39.6	40.8				51.1	45.0	43.5	41.5
95% ≤		38.1	37.9	40.1	41.4				51.4	49.3	44.6	41.9
NUMBER OF OBS		550	339	46	171				102	986	902	693
MEAN RELATIVE HUMIDITY (%)	87	86	88	99	90				89	84	82	79
NUMBER OF OBS	248	569	335	46	173				109	979	890	681
WIND SPEED (KNOTS)												
% FREQUENCY ≥ 34 KNOTS	.8	.0	.7	.0	.0	.5			1.9	1.7	2.5	2.0
5% ≤	2.0	3.0	3.0	3.4	5.0	5.3			5.0	3.0	3.0	4.0
MEDIAN	13.0	14.0	17.0	14.0	12.0	11.0			15.0	16.0	13.0	12.0
95% ≤	29.0	25.5	28.3	23.6	21.0	24.0			27.0	28.9	31.0	27.0
NUMBER OF OBS	248	251	174	168	374	206			54	983	908	686
POTENTIAL SUPERSTRUCTURE ICING(% FREQUENCY)												
MODERATE (AIR TEMP <28F AND WIND ≥13KT)	13.3	10.4	8.2	.0	.0	.0			.0	.0	.0	2.2
SEVERE (AIR TEMP <16F AND WIND ≥30KT)	.0	.0	.0	.0	.0	.0			.0	.0	.0	.0
NUMBER OF OBS	248	250	134	168	373	206			54	982	904	686

AREA: EB10 POR: 1972 - 1974	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
27.5°N, 89.0°W												
SEA LEVEL PRESSURE (MB)												
5% ≤	1011.4	1012.1	1008.6	1008.7	1006.0	1009.8	1013.1	1012.7	1009.8	1012.8	1010.9	1009.2
MEDIAN	1019.2	1020.3	1015.7	1020.2	1015.0	1016.3	1017.0	1016.6	1014.7	1016.8	1017.0	1019.8
95% ≤	1027.0	1026.9	1021.8	1026.2	1021.1	1019.7	1019.8	1019.3	1018.9	1018.9	1023.8	1030.7
NUMBER OF OBS	857	945	806	458	623	692	266	191	257	325	680	926
AIR TEMPERATURE (DEGREES F)												
5% ≤	54.5	53.2	65.3	60.6	72.0	78.1	80.4	79.9	77.7	72.5	62.2	57.0
25% ≤	64.9	61.5	69.6	65.5	76.3	79.7	82.2	81.9	80.8	76.8	66.4	64.0
MEDIAN	71.8	64.9	72.0	70.2	78.8	81.3	83.3	82.9	81.9	79.2	72.7	70.7
75% ≤	73.8	70.7	74.1	75.0	80.2	83.7	86.0	84.6	82.6	81.5	76.5	75.6
95% ≤	77.4	74.7	76.4	78.9	84.0	85.2	89.1	86.5	84.9	84.2	79.7	78.3
NUMBER OF OBS	857	945	806	458	623	692	266	191	257	308	680	924
MEAN RELATIVE HUMIDITY (%)	85	73	85	72	80	76	75	79	84	72	78	79
NUMBER OF OBS	857	936	803	458	621	690	265	191	257	306	680	924
WIND SPEED (KNOTS)												
% FREQUENCY ≥ 34 KNOTS	.0	.2	.5	.2	.8	.0	.0	.0	.0	.0	.0	.0
5% ≤	4.0	4.0	6.0	4.0	2.0	1.0	2.0	2.6	4.0	3.3	4.0	4.0
MEDIAN	13.0	13.0	15.0	14.0	10.0	9.0	8.0	9.0	12.0	13.0	14.0	13.0
95% ≤	24.0	24.0	25.0	24.0	22.0	16.0	15.0	15.0	20.2	22.0	23.0	27.0
NUMBER OF OBS	857	944	805	458	623	692	266	191	257	325	679	910

AREA: EB12 POR: 1973 - 1974	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
28.0°N, 94.0°W												
SEA LEVEL PRESSURE (MB)												
5% ≤	1012.1	1007.2	1010.5	1004.6	1002.8	1004.7	1012.6	1012.5	1003.1	1009.4	1007.3	1007.9
MEDIAN	1016.5	1017.5	1015.4	1015.3	1010.5	1014.1	1015.7	1015.1	1013.3	1015.5	1016.9	1018.4
95% ≤	1023.0	1030.2	1022.4	1022.1	1015.3	1018.8	1018.3	1017.1	1017.3	1018.6	1028.0	1028.6
NUMBER OF OBS	247	224	248	240	262	236	247	247	223	256	240	246
AIR TEMPERATURE (DEGREES F)												
5% ≤	66.4	57.4	70.0	70.0	75.9	77.9	80.6	80.2	79.7	76.3	68.2	58.3
25% ≤	73.8	65.1	72.9	74.1	78.1	80.6	82.6	82.6	81.9	79.0	76.5	66.2
MEDIAN	74.7	70.2	74.3	75.7	79.2	81.9	83.8	83.7	82.8	81.9	79.2	71.6
75% ≤	75.7	73.9	75.7	76.8	80.8	83.3	86.2	86.0	84.7	83.1	80.2	74.3
95% ≤	78.1	76.6	78.3	79.7	84.2	85.6	88.9	88.5	87.3	86.2	82.9	77.2
NUMBER OF OBS	247	224	248	240	262	236	246	247	223	254	240	246
SEA SURFACE TEMPERATURE (DEGREES F)												
5% ≤						82.0	82.8	83.7	82.9			
MEDIAN						82.6	84.6	84.2	84.2			
95% ≤						84.0	86.0	86.2	91.0			
NUMBER OF OBS						71	247	141	106			
MEAN RELATIVE HUMIDITY (%)	86	68	87	81	85	76	77	76	79	71	76	68
NUMBER OF OBS	247	224	248	240	262	236	246	247	222	254	240	246
WIND SPEED (KNOTS)												
% FREQUENCY ≥ 34 KNOTS	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5% ≤	5.0	4.0	4.4	5.0	3.0	4.0	3.0	3.0	2.0	4.0	4.0	6.0
MEDIAN	13.0	16.0	14.0	17.0	12.0	11.0	9.0	9.0	10.0	11.0	13.0	16.0
95% ≤	21.0	24.8	21.0	25.0	21.0	24.0	17.7	15.0	17.0	21.0	25.0	27.0
NUMBER OF OBS	247	224	248	240	262	236	247	247	223	256	240	246

AREA: EB13 POR: 1973 - 1974	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
32.3°N, 75.2°W												
SEA LEVEL PRESSURE (MB)												
5% ≤	1016.3	1003.9	1002.8	1010.4	1008.8	1007.6						1002.4
MEDIAN	1021.6	1016.4	1019.3	1019.3	1017.3	1015.5						1016.4
95% ≤	1028.0	1027.8	1024.6	1028.9	1021.8	1019.3						1027.1
NUMBER OF OBS	221	194	213	187	225	206						277
AIR TEMPERATURE (DEGREES F)												
5% ≤	63.0	52.9	55.6	59.9	69.1	72.9						53.1
25% ≤	70.0	58.3	66.4	65.3	72.0	76.5						58.9
MEDIAN	71.4	64.6	69.8	69.6	73.0	77.7						66.0
75% ≤	72.9	69.3	71.4	73.0	76.8	79.3						70.7
95% ≤	74.3	72.1	73.8	75.0	78.8	81.1						73.6
NUMBER OF OBS	221	194	213	187	225	206						277
SEA SURFACE TEMPERATURE (DEGREES F)												
5% ≤	71.2	70.5	71.4	72.1	74.1	79.0						72.5
MEDIAN	73.2	71.4	73.2	74.8	80.4	81.1						74.8
95% ≤	76.5	72.9	76.1	78.1	83.7	82.4						77.2
NUMBER OF OBS	221	194	212	184	207	206						277
MEAN RELATIVE HUMIDITY (%)	79	66	75	69	76	87						67
NUMBER OF OBS	221	194	213	187	225	205						277
WIND SPEED (KNOTS)												
% FREQUENCY ≥ 34 KNOTS	.0	.6	.5	.5	.0	.0						4.7
5% ≤	5.0	4.0	5.0	3.0	5.0	3.0						4.0
MEDIAN	16.0	19.0	16.0	15.0	11.0	13.0						18.0
95% ≤	23.0	29.0	29.0	26.7	22.8	20.0						33.0
NUMBER OF OBS	221	177	213	187	225	206						277

Smooth Log, North Atlantic Weather

May and June 1974

The SMOOTH LOG (complete with cyclone tracks [figs. 23-26], climatological data from U.S. Ocean Station Vessels [tables 4 and 6], and gale tables 5 and 7), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

SMOOTH LOG, MAY 1974--The number of storms was well above normal, especially over the eastern United States. The two northern primary tracks, across southern central Canada and the Midwest of the United States across the Great Lakes, were normally located, but turned northerly over the St. Lawrence River valley toward Hudson Bay rather than Newfoundland. The storms that affected the North Atlantic and originated over the United States came out of the south and southeastern United States and moved northeastward off the coast.

When over water, the storms usually follow one of two paths, either northward into the Davis Strait or northeastward into the Norwegian Sea near the Faeroe Islands. This month, they headed primarily northeastward, but south of Iceland they curved back northwestward to dissipate south of the Denmark Strait. One storm formed south of Newfoundland, near 38°N, traveled south of the Azores Islands, then across northern Spain and into France.

The climatic mean sea-level pressure chart for May is rather flat, with slightly less than 10-mb pressure difference between the Icelandic Low (1012.3 mb) and the Azores High (1022 mb). The Azores High is the dominant feature, with the 1016-mb isobar stretching like a rhumb line course between Cape May, N.J., and Shannon, Ireland.

This month's mean pressure pattern was more intense, with a 1005-mb Icelandic Low and a 1021-mb Azores High. The 1016-mb isobar had the same curvature and orientation, but was from approximately Miami to Cape Finisterre. Both pressure centers were near their climatological location.

The major anomaly centers were north of 50°N. A negative 8-mb center was near 57°N, 27°W, and a negative 7-mb subcenter was near 52°N, 40°W. The positive centers were even further north--a 9 mb over northern Greenland and an 8 mb north of Frobisher Bay.

As would be expected, the upper-air mean pressure heights closely matched the sea-level pressures, except shifted westward and southwestward. The wind flow at 700 mb (3,000 m/10,000 ft) was mainly zonal between 30°N and 50°N, with a trough line off the U.S. east coast and another off Portugal and northwest Africa.

There were no tropical storms. Historically, one tropical storm may occur every 5 yr, and only once in 21 yr does it reach hurricane intensity.

Early on the 3d, a wave formed west of Norfolk. It moved northeastward up the East Coast and, by 0000 on the 5th, was near Sable Island. The LASH TURKIYE, at 40.5°N, 61.4°W, was headed into 40-kt gales, with 16-ft seas and 20-ft swells. The LOW, at about 985 mb, continued northeastward, creating only minimum gale-force winds. From midday on the 6th until midday on the 7th, the 976-mb LOW stalled near 54°N, 41°W, while it consolidated its circulation. Funneling and downslope probably contributed to the 45-kt gales at Kap Farvel, while the next weather station northward on the east coast reported calm winds. A ship reported 35-kt gales near the center of the LOW. At 0000 on the 7th, Kap Farvel was receiving 55-kt winds, which became 50 kt at 1200. At that time, the DART AMERICA, near 48.5°N, 40°W, was beaten by 45-kt winds off her bow. Earlier at 0600, the BEL HUDSON, at 45.5°N, 40.8°W, measured 42-kt winds, 15-ft seas, and 25-ft swells.

Late on the 7th, the storm started moving eastward, with 35-kt gales in the southern quadrant. The ELSFLETH, TRADER, and Ocean Station Vessel "K" all had 35-kt gales on the 8th and 9th. At 1200 on the 9th, the ATLANTIC FOREST reported 45-kt gales south of the center, near 46.3°N, 13.5°W, and the AMERICAN LEGEND found the same speed at 47.5°N, 14.8°W. The ZAWIERCIE reported 40-kt gales west of the center near 49°N, 26°W.

On the 10th, the 980-mb LOW turned northward over the west coast of Ireland, and the FORT TRINITE, KAKO MARU, and the POSSEHL reported 40- to 45-kt gales. The seas were running about 16 ft, but the KAKO MARU was plowing into 46-ft swells at only 5 kt.

On the 11th, the LOW was moving northwestward, south of Iceland, and weakening. On the 12th, it was absorbed by another, approaching from the west.

Some background--a LOW moved off Cape Hatteras on the 6th and northeastward up the East Coast. A small HIGH was east of the LOW and moving eastward and building. By the 8th, it had combined with the Azores High at 1030 mb and spread westward. This blocked the front in the vicinity of Bermuda, and waves were forming and moving northeastward on the front.

On the 9th, one of these developed more energy and, by 1200, was a 1010-mb LOW. At the same time, another LOW had formed over Cuba and was

racing up the front. Late on the 11th, the two joined forces. Winds of 35 kt were blowing north of the center on the 11th, but late in the day and early on the 12th were below gale force as far as reports were concerned. At 1800 on the 12th and 0000 on the 13th, the JULESBURG had 38- and 42-kt winds with 30- and 26-ft swells, respectively. The ATLANTIC FOREST measured 45-kt winds, 17-ft seas, and 23-ft swells, at 0000 on the 13th.

At 1200 on the 13th, the 986-mb LOW was at 42°N, 33°W, having pushed the HIGH southward and worn down its pressure to 1023 mb. The TOYOTA MARU No. 11, about 150 mi south of the center, was headed toward the Panama Canal at 5 kt, into 50-kt storm winds and 26-ft swells. North of the center about 100 mi, the KAKO MARU was making 15 kt in the same direction, with 40-kt gales and 16-ft swells on her stern. Twelve hours later, the TOYOTA was still on the receiving end of 35-kt gales on her starboard side. At 1200 on the 14th, the AMERICAN ACCORD received 45-kt north-northeasterly gales near 47.9°N, 25.4°W.

The LOW was now turning northward, with only minimum gale winds. On the 16th, the LOW had turned toward the northwest, and Ocean Station Vessels "I" and "J" reported 35-kt gales, with "A" having 40-kt gales. "I" also suffered 25-ft swells from the southeast. On the 17th, as the LOW stalled near 59°N, 31°W, the HINRIK, at 64.5°N, 35°W, came in with 45-kt gales. By the 18th, the LOW had been absorbed by another system.

Only the outskirts of this storm affected saltwater except for Hudson Bay. A few gale-force winds were observed off Nova Scotia, on the 13th. The main concern of this storm was over the Great Lakes.

The LOW formed over Wyoming, on the 10th, and moved east-northeastward. At 1800 on the 11th, it was centered slightly north of Duluth at 990 mb. Four ships reported high winds and waves at that time. The ARTHUR M. ANDERSON measured 38-kt winds near Chicago on Lake Michigan. The other three ships were on eastern Lake Superior and measured the following winds and seas: JOHN DYKSTRA, 46 kt and 13 ft; RESERVE, 38 kt and 10 ft; JOHN SHERWIN, 38 kt and 5 ft. At 0000 on the 12th, the JOHN DYKSTRA was entering Whitefish Bay with 37-kt winds and 11.5-ft seas.

The LOW moved eastward on the 13th and then northward and westward on the 14th, to end up over Hudson Bay on the 15th. There it was absorbed by another LOW moving northeastward from over the Great Lakes.

This LOW came out of the midwest and moved off the coast of Nova Scotia on the 18th. By 1200 the 986-mb center was near 44°N, 51°W. The JAPANA, southwest of the center at 41°N, 55°W, was headed into a 45-kt gale with 17-ft seas. Twelve hours later, the AMERICAN ACE was about 100 mi east of the center with 45-kt winds. The LOW was racing northeastward at about 50 kt and, at 1200 on the 19th, was a 974-mb storm located near 54°N, 27°W. Gale-force winds were reported east and south of the center. Three ships reported 40-kt gales south of the center. The C. P. DISCOVERER came out on the short end of the stick with 16-ft seas and 36-ft swells near 50.2°N, 27.4°W.

On the 20th, the storm was moving northward and slowing considerably in speed. Ocean Station Vessel "A" combatted 40-kt winds. On the 21st and 22d, the LOW stalled midway between Iceland and Greenland, filled rapidly, and disappeared late on the 22d.

During the third week of the month, the Azores-Bermuda High built not so much in pressure, but in area. On the 18th, there was a 1025-mb center over Bermuda, and the 1020-mb isobar circled 30°N from coast to coast. On the 19th, this HIGH was building eastward, and an elongated center formed off the Iberian Peninsula. This effectively blocked the eastward movement of LOWs, resulting in northerly and northeasterly paths. The LOWs also did not develop large circulations and tight gradients for high winds. This situation, called a "blocking High," continued through the 27th, with a maximum pressure of 1039 mb centered near 45°N, 20°W, on the 23d.

When the major high-pressure center moved northward off the Bay of Biscay, low-pressure centers attempted to move to the south. A LOW developed off Morocco and pushed westward, while various LOWs pushed eastward. Finally, on the 26th, a LOW pushed through, separating the misplaced Azores High and the Bermuda High. This LOW moved across northern Spain into France and Germany. This was the only LOW to travel from the western ocean into continental Europe this month. There were no significant winds reported with the low-pressure system, except a 40-kt report by the CASSIOPEE on the 29th, near 34°N, 14°W.

This LOW developed over Georgia on the 26th. At 1200 on the 27th, it was 1002 mb over Cape Hatteras and moving northeastward. At 0000 on the 28th, the ERIC K. HOLZER, at 38.2°N, 72.8°W, was fighting 45-kt gales. At 1200, the JAPAN CEDAR was banged by 45-kt winds, southwest of the center, and the KATJA had 40-kt southerly winds ahead of the front, southeast of the center. At 1800 that day, the PRINCE OF FUNDY measured raging 50-kt winds at 43.6°N, 67.5°W. The AMERICAN ACCORD, near 40.2°N, 60.7°W, battled the same winds with 20-ft waves 6 hr later. At 0000 on the 29th, three ships reported 40-kt gales, two off Nova Scotia and one southeast of the center, near 40.5°N, 56°W. Two of them were the ALERT and the IMPERIAL QUEBEC.

A very significant report was sent by the LEVERKOSEN from near 48.5°N, 49°W. It contained the remark "Icebergs."

At 1200 on the 29th, the 984-mb LOW was at 46°N, 58°W. About 300 mi south, the BIRTE HUGO STINNES was hammered by 50-kt winds, thundershowers, and 23-ft seas and swells. Forty-knot winds were still blowing off Nova Scotia. At 0000 on the 30th, the FRIDA DAN also had 50-kt winds, near 41°N, 59.5°W, and the BIRTE HUGO STINNES still had 45-kt gales. Far to the southwest along the front minor waves were forming and the AUSTRAL PATRIOT was hit by 55-kt winds, while reporting squalls in the area, at 1200 on the 30th.

As the LOW moved past Newfoundland, it weakened, but, on the 31st, still generated 40-kt gales for the USCHIT. On June 1 and 2, the LOW moved southward and eastward of a stationary LOW near Iceland. Late

on the 2d, the two combined.

Casualties--The 290-ton SAN SALVADOR EXPRESS was disabled 60 mi southeast of Nassau. The vessel ran aground and began breaking up in rough seas. Helicopters rescued 49 passengers and 6 crewmen on the 12th. On the 12th, a tornado touched down near Commodore's Point Terminal in Jacksonville, Fla., causing heavy damage to two warehouses and cargo.

The 3,142-ton Rumanian tanker ALAGIR sank after colliding in fog with the French ALPILLES, on the 16th, off the coast of Libya. The crew was rescued.

The 11,682-ton Liberian tanker MELITI, Algiers to New York, stopped at Freeport, Bahamas, on the 18th, with heavy weather damage to the forecastle, which was set down approximately 8 in.

The Canadian IMPERIAL ACADIA (7,068 tons) was reported in heavy ice on the 21st, with a punctured bow and bow thruster room flooded.

In the Panama Canal, the Italian containership MEDITERRANEAN (26,500 tons) and the Belgian carrier TITUS (22,721 tons) collided during a violent rainstorm. The Panamanian tanker MOLAN (1,600 tons) sank in the Mediterranean Sea southeast of Malaga after a collision in fog with the Japanese bulk carrier KIMI MARU (37,179 tons) on the 28th. The crew was rescued by the KIMI MARU, which had damage to the soft nose starboard side and to the bulbous bow.

SMOOTH LOG, JUNE 1974--There was no such thing as a primary storm track this month. The numbers of cyclone centers were below normal, and their paths were confused. According to climatology there is a primary track across southern Canada which splits near James Bay, one branch continues eastward, while the other curves northeastward into Baffin Bay. Another track is across the Great Lakes and is joined by another from off the northeast U.S. Coast. This then extends east-northeastward to the south of Iceland into the Norwegian Sea. A second one, over water, starts south of Newfoundland and parallels the other, about 8° latitude to the south, into the Sheltand Islands. The major similarity this month was an overall easterly trend.

The mean pressure pattern conformed closer with climatology. The Azores High was normally located near 33°N, 38°W at 1022 mb rather than 1023.8 mb. The Icelandic Low was misplaced, near 55°N, 43°W, at 1010 mb rather than over the Labrador coast, near 57°N, 60°W, at 1010.5 mb. It also had another 1008-mb center over Keflavik, Iceland.

The mean departures from normal were small, 4 mb being the largest. A negative 4-mb anomaly was centered over Iceland with a corresponding positive 4-mb anomaly off the Labrador coast. A negative 3-mb anomaly stood out over Cape Hatteras. There was also a negative 3-mb center in midocean near 39°N, 38°W. An elongated 2-mb isoline with a 3-mb center paralleled the northwest African coast.

The upper-air pattern followed its climatological pattern rather closely, with two exceptions. The major Low was further south over Hudson Bay rather than upper Baffin Bay. This was reflected by a trough generally paralleling the Mississippi River. The other was a reflection of the surface Low over Iceland, again at a lower pressure than the primary climatological one. The anomalies closely matched the surface in both location and sign.

Normally one tropical storm will occur every 2 yr and one of these will develop to hurricane strength every 4 yr. None occurred this month.

Not only were there fewer LOWS than normal, they were weak. The pressures were not deep nor were the winds strong. This is normally expected in the summer months but not this early.

The first storm of the month tracked out of the northern plains and was east of James Bay on the 1st, at 988 mb. Early on the 2d, it moved over the water of the Labrador Sea. The JOHN CABOT, near the Virgin Rocks of the Grand Banks, was hit by 35-kt winds. Far to the south between the front and a small HIGH, the GOLDEN GATE found 40-kt gales.

The LOW was south of Kap Farvel, by 1200 on the 3d, and in the meantime a small 1003-mb LOW developed and dissipated in a short time, near 51°N, 47°W. The ALBRIGHT PIONEER was just south of the center and was pounded by 40-kt gales and 12-ft swells. On the 4th, the LOW turned northeastward and, on the 5th, eastward. At 1800 on the 5th and 0000 on the 6th, the HOEGH MERCHANT was in the vicinity of 53°N, 17°W and headed to the north of Ireland. She reported winds of 37 kt and seas as high as 23 ft. A little further south, the SAN FRANCISCO was at 50.8°N, 12.5°W with 35-kt gales and 13-ft seas. On the 7th, the storm brushed the Norwegian coast and turned northward to dissipate over Spitsbergen on the 10th.

This storm formed west of Lake Winnepeg on the 3d. It traveled due east and was still a weak wave on a front on the 5th. As it crossed the Strait of Belle Isle, early on the 6th, another LOW was moving northeastward and was about 500 mi east of St. John's. The QUEENSGARTH was plowing into 40-kt gales north of this center.

The drilling rig VGBZ on Sable Island Bank measured 40-kt winds. When the storm center moved over water it deepened to 994 mb, at 1200 on the 6th, and slowed in its easterly movement. On the 7th, GENE TREFETHEN in Cabot Strait reported 35-kt gales out of the north and the SIR HUMPHREY GILBERT in Notre Dame Bay tended to be pushed toward shore by 40-kt winds.

Twelve hours later, the GILBERT was still being blown by 35-kt gales and the same wind speed band had moved over SEDCO I. The LOW was almost stalled now, east of Newfoundland, and filling. On the 9th, the storm was only an area of general low pressure with several odd centers.

This was one of the LOW's, in the general area of low pressure, over the Gulf of St. Lawrence from the previous system. At 1200 on the 9th, it hit VGBZ with 40-kt gales. The upper-air LOW was north of Newfoundland and the surface LOW raced around its southern periphery. The RED JACKET was buffeted by 40-kt gales and 13-ft seas at 41.5°N, 47.8°W at 0600 on the 10th. At 1200, the LOW was centered at 50°N, 43°W, and the NEW ENGLAND TRAPPER, at 44°N, 43°W, felt the sting of 35-kt gales. On the 11th, the UPJD, ahead of the cold front found 40-kt winds with 13-ft seas and 13-ft swells. By 1200 that day, the

storm's central pressure had dropped to 980 mb near 54°N, 39°W. A ship which appeared to be the GONO was at 53°N, 30°W, and reported 40-kt southerly winds with 16-ft seas and 20-ft swells. To the south and along the front, the ERLANGEN and the MUENCHEN both were battered by 35-kt gales with seas and swells under 15 ft.

As happens many times, when the LOW moved toward the Denmark Strait another center developed south of the main one. Over the colder waters the old center weakened, but continued moving northward and was last seen passing near Spitsbergen.

This LOW had its origins over the normally dry country of west Texas and New Mexico on the 8th. The storm was not dry though, as it produced flooding in Texas and Arkansas with severe thunderstorms and tornadoes. A tornado watch was in effect for the upper Great Lakes region with gale warnings on the 9th. It moved across the midwest and at 1200 on the 10th was over Wisconsin. At that time, it brought strong winds to Lake Superior. The ASHLAND measured 44-kt winds with 15-ft seas, and the WILLIAM A. IRVIN measured 36-kt winds. Both were north of the Keweenaw Peninsula about 60 mi apart, with the ASHLAND further west.

The 995-mb center passed near Sault Ste Marie about 0000 on the 11th. At 0600 the LEON FALK, JR. on Lake Huron had 38-kt westerly winds. Later in the day winds gusting to 35 kt were observed near Lake Ontario and a gale warning was posted.

The LOW continued moving over Ontario Province but was weakening as a stationary LOW over Hudson Bay became the primary system.

This 1007-mb wave formed on a front near 50°N, 24°W. It moved north-northeastward and, at 0000 on the 20th, was near 56°N, 17°W. The GAMNAGAS, at 46°N, 35°W, was being pushed by 35-kt gales on her port side. On the other side of the LOW the WCHU was sailing with 40-kt winds on her port side. On the 21st, the rapidly weakening LOW passed east of Iceland and disappeared.

A front moved southward across the midwest and, on the 24th, paralleled the Gulf coast. At 1200 on the 24th, a wave formed near the Florida-Georgia border. Without intermediate detailed charts it cannot be determined if it remained almost stationary or moved eastward, dissipated, and a new one formed. A tropical depression was in the Bay of Campeche and combined with the frontal wave produced high tides and surf on the Florida west coast. Wind gusts over 50 kt were measured near St. Petersburg.

At 1200 on the 25th, a wave was over central Florida with the beginnings of a circulation. Out at sea in the southerly flow, the ZIM NEW YORK encountered rain showers and 35-kt winds. The DONA CORAZON II, only a few miles away at 31.3°N, 74.9°W, measured 37-kt winds. Closer inshore the EXXON WASHINGTON had 20-ft seas. As the wave moved northeastward, up the northeast-southwest oriented front, off the coast, the CORONADO fought the highest wind for the North Atlantic this month. At 0000 on the 26th, a second wave was off Charleston, S.C.; the CORONADO was near 32°N, 73.5°W, and was being pushed by 50-kt storm winds from the southwest on her northerly track. She reported both 16-ft seas and 16-ft swells. There were three other gale-force reports, all on the warm side of the front. They were the SEALAND VENTURE, USCGC UNIMAK, and the LNML. The BOSTON, at 32.4°N, 73.1°W, fought 45-kt gales and 18-ft seas.

As the wave rolled up the front the drilling rig VC8062 was washed by heavy rain and 40-kt winds at 1200. By 0000 on the 27th, the apex of the wave was about 300 mi south of Argentia and ready to give up the fight. It could not develop the closed circulation that is needed for long life.

This storm started out as a weak tropical depression on the 22d, in the Bahia de Campeche. The depression never developed into anything more than a cloud mass, but was closely watched by the National Hurricane Center. Winds of 30 kt were reported. On the 26th, a front moved far enough south to be pulled into the circulation, and the system changed to extratropical. Two tankers in the Gulf of Mexico near 25°N, 84.5°W, were contending with 35-kt gales, seas of 10 ft, and swells to 15 ft. They were the MOBIL AERO and SOCONY VACUUM. The front started moving northward, and crossed into Florida early on the 27th. Tides were up to 3 ft above normal and heavy rains occurred, with over 10 in within 30 hr being measured near Tampa. Tornadoes also broke out all over the State.

At 0600 on the 28th, the 1010-mb LOW was over Cape Hatteras. The GYPSUM PRINCE was off Cape May and had 40-kt gales from the east-northeast. A HIGH was pushing south and southeastward out of Canada across New England. This forced the LOW inland over Delaware Bay. Heavy rains had occurred over the coastal regions of North Carolina and Virginia. Gale warnings were posted along that section of the shore.

By 1200 on the 29th, only the frontal system and a trough remained as the HIGH continued to push southeastward.

Casualties -- The collision in fog with the 10,974-ton Greek NEMA sank the 6,424-ton Greek NATCREST off the Brest Peninsula on the 16th. The crew was rescued. The Danish WIVI BEWA (1,399 tons) was delayed by ice and sustained leakage in the forepeak. Vessel was due Stephenville on the 26th. The German motorvessel HOHEWEG (724 tons) was taken in tow by the ELKE KAHRS, about 70 mi from Bilbao, and returned to Bilbao, on the 23d, with a slight list due to heavy weather. The 12,387-ton Greek tanker KANARIS went aground in the Orinoco River at mile 12 during a rainstorm. Assistance was called for after initial attempts to refloat were unsuccessful. The nonpropelled dredger MIAMI (1,025 tons) sank on the north side of the channel to Ocean Cay, on the 26th, after the port side spud broke in heavy weather and punctured the hull when the vessel swung.

Smooth Log, North Pacific Weather

May and June 1974

SMOOTH LOG, MAY 1974--The number of cyclones was above normal, and they tended to be small and not intense with large circulations. The overall pattern of their tracks was near normal, but there were significant displacements. The primary track across the Sea of Okhotsk was normally located, but the primary climatological track south of Japan was located further north, across the Yellow Sea and Sea of Japan. More storms tracked into the Bering Sea than normal. This resulted in fewer storms moving eastward, south of the Aleutian Islands and into the Gulf of Alaska, where the storm tracks were further south than the climatic mean.

The sea-level pressure pattern closely matched the climatological pattern. The Aleutian Low, at 1004 mb, was near its 1008.5-mb climatic position of 55°N, 180°. The Pacific High occupied the greatest expanse of the area and was centered on about 35°N. The major center was 4 mb higher in pressure, at 1026 mb, than the 1022.2-mb climatological center and 10° longitude further to the east, near 35°N, 140°W.

The anomalies were relatively small, but they help in understanding the displacement of the tracks. There was a small negative 4-mb center collocated with the Aleutian Low. There were three positive centers of some importance--a 6 mb near 40°N, 130°W, which affected the U. S. west coast; a 4-mb center near 40°N, 155°E, off Japan; and a 4-mb center over the East Siberian Sea.

The upper-air Low at 700 mb was stacked nearly vertical with the sea-level Low and slightly lower than the climatological mean. There were two other negative anomalies, both of which were greater than the one connected with the primary Low. One was located over the Queen Charlotte Islands, and the other, slightly east of the tip of the Kamchatka Peninsula. Since these were not reflected at sea level, they could help explain the slight shift in storm tracks. As normal, the main flow was zonal, centered on about 40°N.

There were two tropical cyclones, one in the eastern and one in the western Pacific. They were tropical storm Aletta and typhoon Carla.

This first storm of the month was over the Sea of Japan on the 1st. It moved eastward with extratropical Babe approaching from the southwest. At 1200 on the 2d, the 994-mb LOW was near 45.5°N, 157.5°E. The remnants of Babe were near 35.5°N, 159.5°E. The NORBROTT, at 32.5°N, 158.6°E, found 35-kt gales south of extratropical Babe. The BEISHU MARU was near 41°N, 154°E, and reported 40-kt gales. The LOW moved northeastward on the 3d and then eastward along the Aleutians on the 4th, at 980 mb pressure. By 1200 on the 4th, Babe no longer existed. Two ships, the FORTUNSTAR and LONG LINES, reported 35-kt gales south of the center.

At 0000 on the 5th, the LOW was centered near 50°N, 173°W. The EAST RIVER, at 43.4°N, 174.6°W, was buffeted by 45-kt gales. Further to the southwest, three ships reported 40-kt gales. They were the EMMA JOHANNA, with 26-ft swells, the OIGAWA MARU, and the PHILLIPS OKLAHOMA. Three hours later, the EMMA JOHANNA had 46-kt winds, 15-ft seas, and 23-ft swells. At 1200, the EAST RIVER still had 45-kt gales, and the swells had built to 26 ft. On the 6th and 7th, the LOW raced into the Gulf of Alaska, where it filled rapidly.

This storm formed as a diffuse LOW over Mongolia on the 1st. By the 2d, frontogenesis had occurred as it moved across Manchuria. On the 5th, it moved across the Kuril Islands and a ship reported 40-kt gales. On the 6th, the storm deepened rapidly and was 962 mb over Agattu Island at 0000 on the 7th. At that time, the HAKUHO MARU was fighting 45-kt winds and 26-ft seas near 46°N, 167.5°E, while the GOLDEN EXPLORER, HOYO MARU, and the SHOZUI MARU were contending with 40-kt gales and seas and swells up to 20 ft.

The LOW continued deepening to 956 mb at 1200 on the 7th, over the Bering Sea, but, 12 hr later, the cold water started weakening it. South of the Aleutian Islands, ships were reporting gale-force winds as far south as 43°N. The SHOKAI MARU, at 51.5°N, 153.5°W, east of the front, had 40-kt southerly winds. At 1800, the PRESIDENT TAFT was at 52.5°N, 176.4°E, about 300 mi southwest of the center, with chilling 50-kt storm winds.

On the 8th, the LOW turned north and northwestward and stalled for 48 hr near 59°N, 175°W, while it slowly disintegrated. During that period several ships felt its 35- to 45-kt wrath. They were, among others, the ARCTIC TOKYO, NORTH STAR, SEA-LAND RESOURCE, and the USCGC JARVIS.

Monster of the Month--A 998-mb wave formed over the Sea of Okhotsk on a weak cold front on the 9th. Another LOW was near Nagoya, Japan, and moving northeastward. By 1200 on the 10th, the two circulations had combined into a 987-mb LOW near 48°N, 160°E. The highest winds were in the warm sector, near the warm front. The YAMASHIN MARU, at 39°N, 166°E, had 45-kt southerly winds on her starboard side. The LOW was deepening as it moved northeastward into the Bering Sea near Agattu Island, as the previous storm had done. The ASHBY MARU, near 44°N, 175°E, had 45-kt winds with the passage of the cold front.

At 1200 on the 11th, the SHIN HONSHU MARU was near 50°N, 180°, just south of Amchitka Island, and fighting 50-kt storm winds with 23-ft seas and swells. Six hours later she measured 56-kt winds and 21-ft waves. Earlier at 0600 the MIDAS RHEIN at 47.6°N, 178.1°W measured 54-kt winds with 12-ft seas and 23-ft swells. At 0000 on the 12th, the LOW reached its lowest pressure of 961 mb, near 54.5°N, 173°W, where it turned eastward to parallel 55°N. The MIDAS RHEIN was at 48.5°N, 172°W, with 55-kt winds and 23-ft swells on her stern. Not far to the north, the IRISH STARDUST was being washed by 45-kt gales

near 51°N, 170°W. This was the largest LOW that transitted the North Pacific this month. The AMERICAN MAIL, at 53.4°N, 175.6°W, had 12-ft seas and 36-ft swells with 45-kt winds. The 40-kt wind band about 400 to 600 mi southwest of the center, was outlined by the BARON ARDROSSAN, SHINTO MARU, and the SHINYO MARU on the 13th. At 1200 the AMERICAN MAIL was still combatting 48-kt winds, 12-ft seas, and 36-ft swells, now from the north. That day, the LOW entered the Gulf of Alaska, and, by the 15th, the pressure had risen to over 1000 mb. The LOW turned southeastward and tracked down the coast, where it dissipated on the 16th. Early that day, the MARGARET CORD was banged by 45-kt gales, but these were associated more with a HIGH moving toward the coast than with the LOW.

This cyclone had its origin near Ostrov Urup on the 16th. It formed in a trough at the occlusion point of a front. The MAMMOTH FIR was at 51°N, 164°E, and found 50-kt winds. The AMERICAN MAIL was really having a rough voyage. At 0600, she reported 47-kt gales, 30-ft seas, and 35-ft swells near 45.8°N, 155.3°E. The LOW moved northeastward up the island chain and, at 0000 on the 17th, was over the tip of the Kamchatka Peninsula. The HOTAKA MARU was near 49°N, 160°E, with 35-kt gales. As the LOW crossed over into the open water, it started to fill, and, by the 19th, had disappeared.

This LOW started out as an easterly wave, and, with a little help, it could have been a typhoon. The wind speeds reported were high enough. On the 15th and 16th, there was only a wave, but at 1200 on the 16th there were indications of a closed circulation. At that time the HAWAII BEAR, at 28.4°N, 174.3°E, had 50-kt northeasterly winds with 33-ft swells. Other ships in the area were getting 35- to 40-kt winds. At 0000 on the 17th, there were two ship reports from the area, and the center was analyzed near 24°N, 174°E, at 990 mb. The GUAM BEAR was near 25°N, 175°E, and reported roaring 65-kt winds at 0000 and 0600. To the northwest, the HAGOROMO MARU was near 26°N, 172.5°E with 50-kt winds. The HAWAII BEAR was at 29.6°N, 178.3°E, at 1200, also with 50-kt winds and 33-ft waves.

Wind and pressure reports from ships on the 18th indicated the LOW was moving northward. None were close to the center or previous area of high winds. As the LOW moved northward, it started to fill, and the area of circulation decreased. By the 21st, only a cold trough was left. The GUAM BEAR still did not have clear sailing as she moved westward. At 1200 on the 20th, she encountered another easterly wave with 50-kt winds, near 17.4°N, 154.3°E.

There were several LOWs that moved over the northern waters, but none that generated significant weather during the remainder of the month. The main features were two large HIGHs, one over the central ocean and one off the California coast. These effectively blocked development of any strong storms.

Tropical storm Aletta was first detected by satellite late on the 27th near 15°N, 100°W. Maximum winds were 35 kt close to the small storm's center. Aletta intensified and moved toward the northwest at 6 kt. On the 28th, maximum sustained winds reached 50 kt as Aletta paralleled the Mexican coast. On the 28th and 29th, four ships reported gale-force winds in her vicinity. They were the CHASTINE MAERSK, GULFPRINCE, PENNMAR, and TEXAN. On the 29th, she turned northeastward and moved inland near Manzanillo. Once inland, Aletta dissipated.

Typhoon Carla formed in the wake of tropical storm Babe, about 5 days behind her. She followed almost the exact path. However, Carla was much better developed--where Babe was a depression, Carla was a tropical storm. Where Babe was a tropical storm, Carla was a typhoon. Carla passed Saipan on the 2d as a tropical storm. By the 4th, she was a typhoon. She reached a peak early on the 5th, when maximum sustained winds climbed to 85 kt near her center, which had just crossed the 20th parallel near 144°E. The THOMAS B. KIMBALL encountered southeasterly 40-kt winds at this time, some 180 mi northeast of Carla's center. Carla accelerated northeastward and weakened as cold air entered her system. Late on the 6th, she turned extratropical as she crossed the 30th parallel near 154°E.

Casualties--Since the storms were few and weak, there were no weather casualties that came to our attention. It was noted that the 9,646-ton Cypriot GEORGIOS T. was disabled with engine damage in some heavy weather on the 19th, on the way to Vancouver. The tug ARTHUR FOSS was engaged to tow the vessel.

An item of interest--Australian Air Force helicopters braved gale-force winds on the 26th to rescue 33 crewmen from the Norwegian freighter SYGNA (52,950 tons). The ship went aground off Newcastle, New South Wales, and broke in two. As it continued to break up, the crewmen were rescued. Earlier attempts at rescue failed because of high surf and 70-kt winds.

SMOOTH LOG, JUNE 1974 -- There were relatively few extratropical cyclones over the Pacific this month. Many were short-lived. The storm tracks approximated the climatological mean paths in general but wandered and looped about this mean. The primary path extends from southern Japan to the Gulf of Alaska. A secondary track across Sakhalin Island into the southern Bering Sea and Alaska was not present. A new feature this month is a secondary storm track across northern Siberia and Alaska. As far as this month is concerned, it would be considered a primary track as there were more cyclones concentrated along a narrower path than elsewhere in the North Pacific. These should probably be considered Arctic Ocean rather than North Pacific storms.

The sea-level pressure pattern in the eastern North Pacific was near normal, and dominated by the Pacific High, centered near 35°N, 145°W, at 1025 mb. A sharper than normal trough in the Gulf of Alaska pushed southward into the High. The heat Low over the southwestern United States was well entrenched, 3 mb lower than the normal 1009-mb pressure. In the western half the gradient was very flat. There was a closed 1011-mb Low, near 42°N, 167°E, and a closed 1017-mb High over the Bering Sea. Normally there is an east-west oriented trough over the Bering Sea.

The anomaly pattern was complex, with many small centers. The trough in the Gulf of Alaska produced a minus 3 mb. The largest negative anomaly was minus 4 mb centered near 35°N, 170°E. A positive anomaly up to 4 mb was situated off the U.S. west coast. There was also a plus 6-mb center over the Bering Sea and a plus 5-mb center over the Sea of Okhotsk.

There were several variations from climatology in the upper air. The climatological normal shows a Low over the Bering Sea near 60°N, 175°E, and an elongated High with two centers straddling 25°N. This month there were three misplaced Lows; one over Manchuria, a small center near 47°N, 170°E, and a closed center over the Gulf of Alaska. An odd ball High was centered over the Sea of Okhotsk. All four of these misplaced centers were reflected by large anomalies--168 to 195 ft in the height of the 700-mb pressure surface.

The Pacific hosted seven tropical cyclones; two hurricanes and one tropical storm in the east, and two typhoons and two tropical storms in the west. They were: Blanca, Connie, and Dolores; and Dinah, Emma, Freda, and Gilda, respectively.

A front out of a LOW over Manchuria moved across Japan on the last day of May. On the 1st, a 993-mb LOW formed at the triple point of the occlusion, near 41°N, 146°E. The MOSBAY, at 40.7°N, 153°E, measured 38-kt winds. The old LOW remained with the upper-air LOW while the new one was under the influence of the upper-air zonal flow and raced eastward. By 1200 on the 2d, it was 986 mb at 39°N, 174°E. The ALEKSANDER VERMISKEV, just south of the center at 37.5°N, was obscured by drizzle driven by 40-kt winds. Far to the west and just north of the east-west oriented front the OSTROGOZHSK had 35-kt easterlies and drizzle with 20-ft seas.

On the 3d, the storm turned northeastward and, by the 4th, was at 49°N, 166°W at 970 mb. Late on the 3d and early on the 4th, there was a rash of gale-force reports around the storm. The SHINYO MARU, near 44.5°N, 166°W, and THE LAUREL, near 47.5°N, 174°W, both suffered 45-kt gales. The SHINYO also reported 13-ft seas and 26-ft swells. The TRANSINDIANA, to the southeast of the center near 47°N, 162°W, contended with 40-kt winds and no seas plotted. She was at 46.4°N, 161.2°W at 0600 with 50-kt winds, 20-ft seas, and 30-ft swells.

The TRANSINDIANA was moving eastward with the storm and continued to receive high winds and seas on the 5th. At 0000 on the 6th, the SIBIR, south of the 990-mb center, near 49°N, 140°W, was hammered by 40-kt gales. The HAVIS, 1.9° latitude to the north, also had 40-kt winds and raging 16-ft seas and 38-ft swells. A few hours after 1200 on the 6th, the storm disintegrated on the shore of British Columbia.

This was a slow-developing storm. The first indication was a small closed LOW over interior China at 1200 on the 1st. It moved slowly east and southeastward, developing a front, on the 2d, as it moved over the Yellow Sea. Movement was very slow with little development of circulation until it turned northward on the 5th and 6th.

Late on the 6th, the center made an abrupt change to an easterly direction. Over the confluence of the Kuroshio and Oyashio Currents the storm intensified. The LIECHTENSTEIN, near the frontal triple point at 39°N, 156°E, found 35-kt southeasterlies with 16-ft seas and 13-ft swells, at 0000 on the 7th. Later on the 7th and 8th the GOLDEN ARROW and the SHIKISHIMA MARU were bounced by 35-kt gales. The MINETAMA MARU, near 40°N, 167°E, was rolled by 40-kt winds on her port side. Again these were near the frontal triple point in the warm sector. At 0600, the MANDARIN VENTURE, at 36°N, 168.7°E, measured 36-kt winds, 23-ft seas, and 30-ft swells.

On the 9th, the 982-mb storm was near 47.5°N, 162°E. The SHIKISHIMA MARU, still in the same general area east of the southern tip of the Kamchatka Peninsula, received 40-kt northerly winds with 12-ft seas and 15-ft swells. At 1200, the 7KTK at 47.2°N, 159.2°E also had 40-kt gales with the waves running 13 and 16 ft. The center was moving very slowly now and had filled to 994 mb by 0000 on the 10th. The TRANSOCEAN TRANSPORT was sailing southward, near 50°N, 177°E, with 35-kt southeasterlies. The waves in the area had built to 25-ft seas and 25-ft swells.

The LOW was pushing against a stubborn HIGH which was drifting eastward very slowly. By 1200 on the 13th, the LOW had worn away and disappeared from the charts.

The Pacific HIGH was firmly entrenched off the California Coast, and a heat LOW was centered over the California-Arizona border. Winds had been blowing up to 25 and 30 kt off the coast. Late on the 6th, the HIGH intensified very slightly and the pressure of the LOW dropped 5 mb to 997 mb by 1200 on the 7th. At that time, the EWUZ reported 45-kt gales, just off San Francisco. The HAWAIIAN QUEEN and the MONTANA, both further off the coast, both reported 35-kt winds. On the 8th, the TOYOTA MARU No. 12 was moving south, near 36.5°N, 126°W, with 35-kt northerly winds and 16-ft swells. Later that day, the LOW started moving eastward relaxing the gradient and decreasing the wind speed.

On the 8th, the North Pacific east of 180° was dominated by three high-pressure cells. An old weak front stretched westward from northern California. Late on the 8th, a wave formed on the front between two of the HIGHs. It quickly developed to a tight 1008-mb circulation. The LOW center crossed directly over Ocean Station Vessel "P" just prior to 0900 on the 9th. At 0900 "P" was hit by 40-kt northwest winds. At 1200, they were 30 kt. To the south, near 52.5°N, 140°W, the J. H. TUTTLE had 35-kt gales. Twelve hours later, she was still on the receiving end of 35-kt winds. On the 11th, the LOW was approaching Alaska's southeast coast and by the 12th had disappeared.

On the 0000 chart of the 13th, a frontal wave was analyzed just off the China Coast in the East China Sea. It moved rapidly eastward under the upper-air zonal flow with no intensification, until the 15th. By 1200, it was at 38°N, 155°E and 992-mb pressure. The PRAG, at 34°N, 155°E, experienced 35-kt gales just prior to frontal passage. At 0000 on the 16th, the TAMA MARU was being overtaken by the LOW, which passed southeast of their track, and was washed by

40-kt gales. The JAPAN BEAR, near 42.5°N, 163.7°E at 0600, was tossed by 46-kt winds out of the east-northeast.

At 1200 on the 16th, the LOW was 992 mb at 41°N, 162°E. The PITTSBURGH was about 120 mi south of the center, and the SAGANOSEKI MARU was about 300 mi north of the center. Both had 40-kt winds, and neither reported sea conditions. Both ships were traveling eastward, and 12 hr later both reported 35-kt gales. The PITTSBURGH was riding with 7-ft seas and 18-ft swells. The SAGANOSEKI MARU was headed into 10-ft seas and swells. The GUNVOR MAERSK, at 0000, was at 40.8°N, 164.5°E with 55-kt westerly winds. The JAPAN BEAR, keeping pace with the storm, measured 45-kt winds at 0600.

Late on the 17th, the storm recurved westward and on the 18th was moving southward. At 0000, the MAMMOTH FIR, near 46.5°N, 161.5°E, about 180 mi northwest of the center, was hammered by 50-kt winds. On the 19th and 20th, the storm stalled near 40°N, 165°E and weakened rapidly. On the 20th, a new center developed to the south, and on the 21st the storm dissipated into the new center.

A fairly large LOW was stalled, near 38°N, 169°E, on the 23d. The front had moved eastward and northward out of the center and a new LOW formed, northeast of the old center, near 49°N, 177°W. Its circulation developed rapidly as it crossed the Aleutian Islands into the Bering Sea. Late on the 24th, it crossed the Alaska Peninsula and Kodiak Island with a central pressure of 992 mb. The ALASKA STANDARD was in Shelikof Strait and was fighting 40-kt winds and heavy rain at 0000 on the 25th.

Twenty five- and 30-kt winds were prevalent throughout the storm's circulation, but the next gale-force winds were not reported until 1200 on the 26th. At that time, the 988-mb LOW was at 52.5°N, 143°W. Ocean Station Vessel "P" and the J.H. TUTTLE near 51°N, 150°W both reported 35-kt gales. The storm turned eastward, on the 27th, from a southeasterly track and began to weaken rapidly. By 0000 on the 28th, it was only a 1009-mb weak area in the pressure gradient, and by 1200 was replaced by a ridge of high pressure.

Monster of the Month--There was no storm this month in either the North Atlantic or North Pacific which was worthy of that name.

Tropical Cyclones, Western Pacific--Dinah was the first tropical cyclone this season to develop west of 140°E. She was detected as a tropical storm on the 8th, about 180 mi east of Samar, in the Philippine Sea. Dinah headed west-northwestward and neared Luzon, on the 9th, as a typhoon. She was already dumping heavy rains throughout the Philippines. She crossed Luzon late on the 9th. In her wake Dinah left 71 persons dead, 14 others missing, and $1 million damage. Most of the destruction came from floods and landslides triggered by the heavy rains.

Weakened by her trek overland Dinah entered the South China Sea as a tropical storm. She headed westward and reorganized. By the 12th, Dinah, once again a typhoon, had turned northwestward. Winds around her center climbed to 75 kt with gusts to 90 kt. After passing east of Hainan the typhoon turned westward and pummelled the Luichow Peninsula on the 13th. After this blow to her circulation Dinah moved across the Gulf of Tonkin as a tropical storm. Later in the day she crossed the coast of North Vietnam.

Two tropical storms flared up briefly about midway through June. Emma developed off the coast of Luzon, on the 15th, and Freda popped up northwest of Marcus Island on the 21st. Although Emma reached tropical storm intensity in a dangerous area she was already beginning to recurve so Luzon was spared the full brunt of a second storm within a week. Winds near her center reached 60 kt with gusts to 75 kt late on the 15th. She weakened after that as she turned northeastward paralleling the Ryukyu Islands. By the 18th, she dropped to depression strength. Three days later Freda developed into a tropical storm near 25°N; this is fairly far north for tropical development. Winds reached 40 kt near her center for a brief period on the 21st. However, by the following day the eastward-moving storm had weakened to a depression near 25°N, 165°E.

Japan got its first taste of the tropical cyclone season in the beginning of July. Typhoon Gilda roared through the Ryukyus and up the East China Sea. In her wake 136 people were dead or missing.

Gilda was spawned from a northwestward moving tropical depression, on the 1st of July, near 20°N, 134°E. The following day she was a typhoon. Winds of 65 kt blew close to her center. Gales extended out to 150 mi. Gilda continued to grow. Early on the 2d, the NORSE LION was surprised by 45-kt southwesterlies some 200 mi to the northeast of Gilda's core. The SHINKYOKU MARU battled gale force winds in 15-ft seas for most of the 2d; she was 100 to 200 mi away from the center. Some 300 mi away the MATSUMAE MARU ran into 18-ft seas and 35-kt winds. Gilda hit her peak late on the 4th as she hit the Ryukyus just south of Okinawa. Kume Island reported maximum winds of 101 kt at about 1600 on the 4th. At that time, winds near Gilda's center were estimated at 95 kt with gusts to 115 kt and gales extending out 150 to 200 mi. The real damage was done by torrential rains. Hardest hit was Shodoshima Island, a tourist resort off Kobe. Torrential rains triggered three landslides in a 3-hr period late Saturday night (6th). Seventeen people died and three were missing in these slides. This was the result of about 12 in of rain in less than 24 hr and 2.34 in in one hr. At Ako, Hyogo Prefecture, 11.97 in fell in less than 24 hr.

Gilda was felt most in Shizuoka Prefecture with 44 persons dead or missing and considerable damage. Up to 19 in of rain triggered devastating landslides and floods. Throughout Japan some 560 houses were washed away.

Gilda moved northward through the East China Sea. She began to weaken some as cold air intruded into her circulation. She fell to tropical storm strength as she tried to squeeze through the Korea Strait on the 6th. Once into the Sea of Japan Gilda became extratropical and weakened slowly.

Tropical Cyclones, Eastern Pacific--Northwest winds of 30 kt by the CHIEH HSING 420 mi south-southwest of Manzanillo, Mexico, at 1800 June 4, was the first indication that tropical storm Blanca was forming near 11.5°N, 106°W. Successive satellite pictures showed

a westerly movement of 12 to 15 kt with little change in intensity during the first 24 hr. During the following 24 hr, the disturbance slowed to an average of 7.5 kt and increased to tropical storm intensity near 13°N, 113°W at 1800 on the 7th. Winds were estimated at 35 kt.

During this development the AMERICAN RELIANCE, CHIEH HSING, TAIKYU MARU, THEREN, and the WORLD BANNER helped locate the cyclone though all were well away from the center.

A gradual curve northward took the storm to near 14.5°N, 116°W, at 0000 on the 8th, having reached a maximum intensity of 50 kt at 1800 on the 7th.

As Blanca moved northward over cooler waters decay was rapid. By 1600 on the 8th, winds had decreased to 25 kt near 17°N, 117°W.

The storm travelled in an area of shipping, but no winds of gale force (34 kt or higher) were reported.

A low-pressure circulation was apparent in satellite pictures beginning June 6, centered about 500 mi south of Zihuantaneo, Mexico. No vessels were in the vicinity until 1800 June 7 when the BARCELONA MARU and the JOHN PENN showed east and west 15-kt winds respectively, each about 100 mi from the center. A northwesterly direction of movement at 5 kt was indicated in successive satellite pictures, on the 7th, but the depression slowed as it intensified to tropical storm Connie, at 0000 June 9, near 12°N, 105°W. A 3- to 4-kt movement continued to near 13.5°N, 109.5°W with wind speeds of 35 to 40 kt.

A more westerly movement began, at 0000 on the 11th, near 13.5°N, 107.5°W, and winds increased to hurricane force, at 1800 on the 12th, near 14°N, 110°W. This was the first hurricane spotted by the Geosynchronous Operational Environmental Satellite (GOES) from some 22,000 mi above the Equator at 45°W. Further intensification to 110 kt was indicated, at 0000 on the 14th, near 16°N, 113°W.

Reports from the AMERICAN LEGION and the HOLY about 75 mi north and south of the hurricane, respectively, indicated only 25 kt in their 1800 observations on June 13. This indicated the concentrated circulation that occurs in some of the eastern North Pacific hurricanes. At that time the winds were estimated as 90 kt near the center.

A gradual curve in the hurricane took the center to 16°N, 113°W, at 0000 on the 15th, with the winds weakening to 75 kt and further weakening to a tropical storm at 0000 on the 16th.

As Connie moved over cooler waters she weakened further and curved eastward, forming a loop near 17°N, 112°W, on the 17th and 18th. She became a tropical depression and regenerated to a tropical storm for about 24 hr near 17°N, 107°W, and then curved northwestward again through the 21st. The disturbance dissipated near 21°N, 111°W, at 0000 on the 22d, but a swirl of cloud was still evident in the area through the 23d.

A tropical disturbance began developing on June 13, 300 mi south of Salina Cruz, Mexico, and bulletins on Dolores were issued beginning 0600 June 14. The center of the squally area was near 12°N, 98°W. Early morning satellite pictures showed more definite development, near 13°N, 97°W, at 1200 on the 14th, and a tropical depression bulletin was issued.

ATS-3 pictures showed rapid intensification, during the morning of the 14th, and, by 1800, it was apparent that a hurricane was forming. The TURANDOT, at 14°N, 98.2°W, reported 30-kt winds 150 mi south of the center. Winds near the center were estimated at 50 kt.

Early forecasts moved the storm west-northwestward, but, by 1930 on the 15th, it was apparent that the storm was taking a more northerly track. The PRESIDENT PIERCE reported an easterly wind of 45 kt at 0000 on the 15th, the first verification that a tropical storm had developed. At 1200, the HU YUNG reported a wind of 5 kt near the center but gave no indication of having passed through heavy weather during the previous 3 to 6 hr. The RIO CALCHAQUI, about 100 mi east of the center, reported south-southeast winds of 45 kt.

At 1800, SHFT reported 40-kt winds, the BRUNSWICK and the PANDO POINT reported 50-kt winds. An 1840 Air Force reconnaissance flight into the storm found maximum winds of 62 kt at about 9,750 ft. The wind speed at about 10,000 ft has been found to be nearly equal to that on the surface. The eye was reported initially at 15.8°N, 98.9°W thus relocating the storm center 80 mi north-northeast of its earlier extrapolated position and changing the direction of movement from northwest to north-northwest. The location was later corrected one degree farther south due to a communication error, but an onshore movement was still indicated to near Acapulco within 24 hr. The storm increased to hurricane intensity by 0000 on the 16th. At 0600, the GREEN LAKE, near 15.4°N, 99.6°W, fought 55-kt winds from 290°.

The hurricane went onshore, about 1300 on the 16th, about 40 mi east-southeast of Acapulco. At 1200 the GAGE LUND and OCEAN HOPE both reported a 55-kt easterly wind near 16.3°N, 99°W, or 60 mi southeast of Acapulco, and by 1800 all winds along the coast from 95°W to 105°W were westerly.

Westerly winds of 25 to 35 kt along the coast continued through 0000 June 17 when hurricane advisories on Dolores were discontinued. A strong westerly wind west-southwest of Acapulco, and an unidentified vessel report of westerly 50-kt winds at 15.5°N, 100.3°W suggested that the hurricane had made a loop and moved offshore to about 40 mi south of Acapulco. This belief was held through 1200 on the 17th. A review of time lapse motion pictures for the mornings of June 16 and 17 show that Dolores probably went onshore on the 16th, and that the strong westerlies were from squalls and heavy rains that were reported by vessels during the night of the 16th, and were post hurricane activity.

The heavy rains over Guerrero caused considerable flooding, washed out highways and bridges, and caused mud slides that took nine lives. News reports indicated another 13 to be missing several days after the storm ended.

Casualties--Mexican coastal waters were searched for the 63-ft yacht SHOOTING STAR, after a "Mayday" call on the night of the 15th. Ten persons were aboard. The yacht reported in trouble with 20-kt winds and 15-ft waves in advance of hurricane Connie. A solo transpacific voyager aboard the 6-ton raft INANNA, made of empty oil drums, was rescued, on the 23d, by the Japanese tuna-fishing vessel No. 17 HIYOSHI

(Continued on page 410.)

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

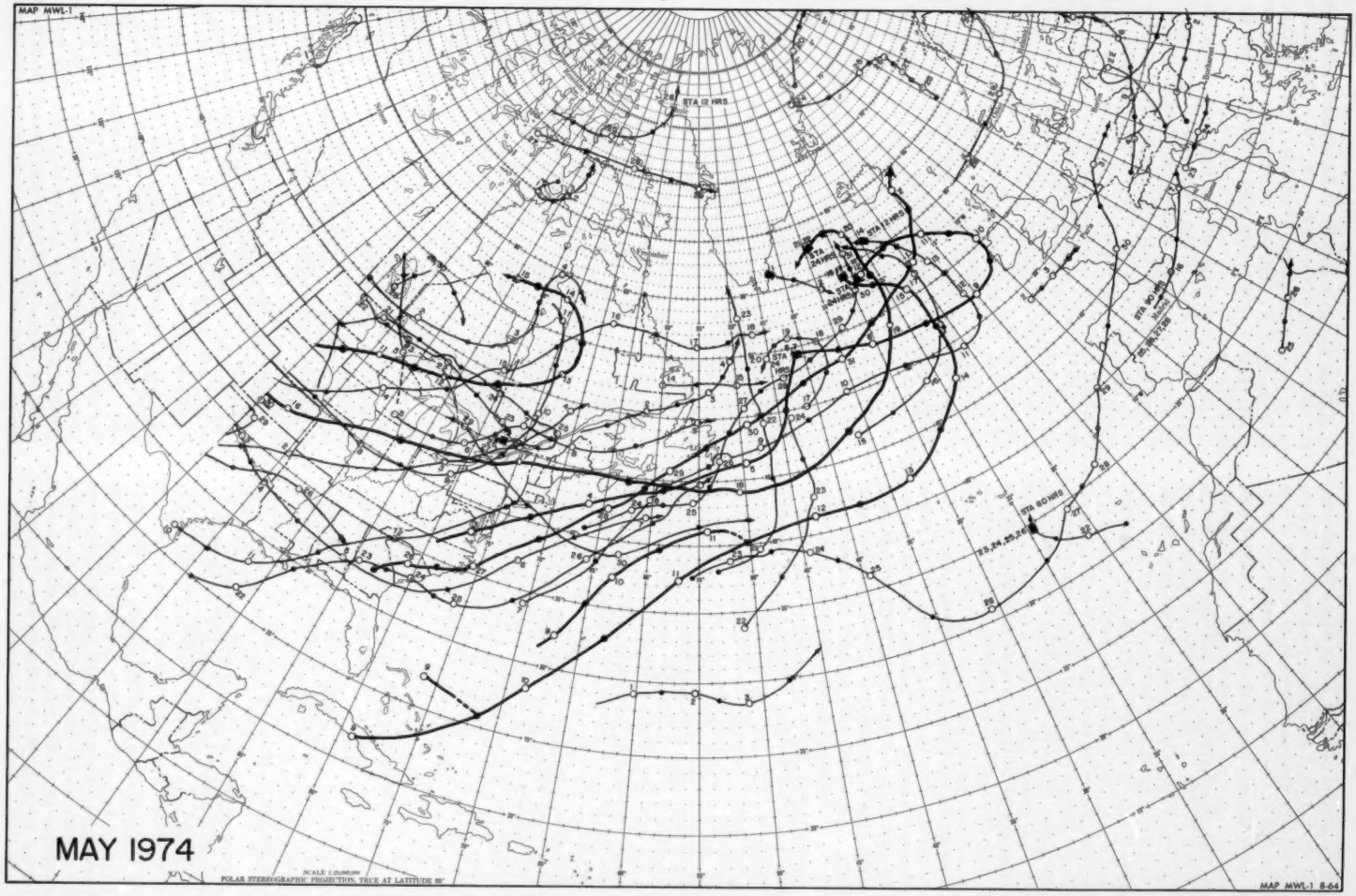


Figure 23. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

Figure 24.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

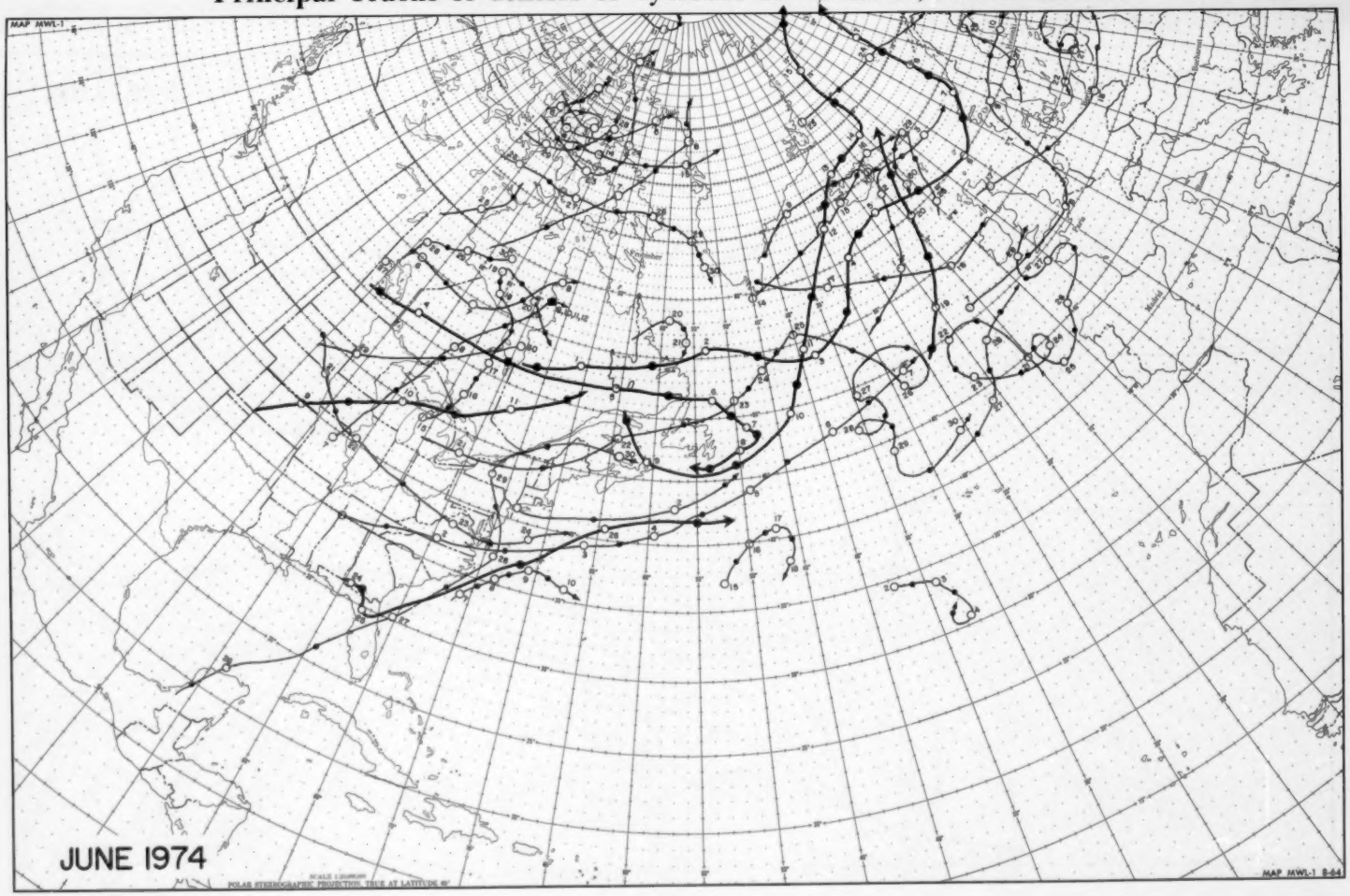


Figure 24.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

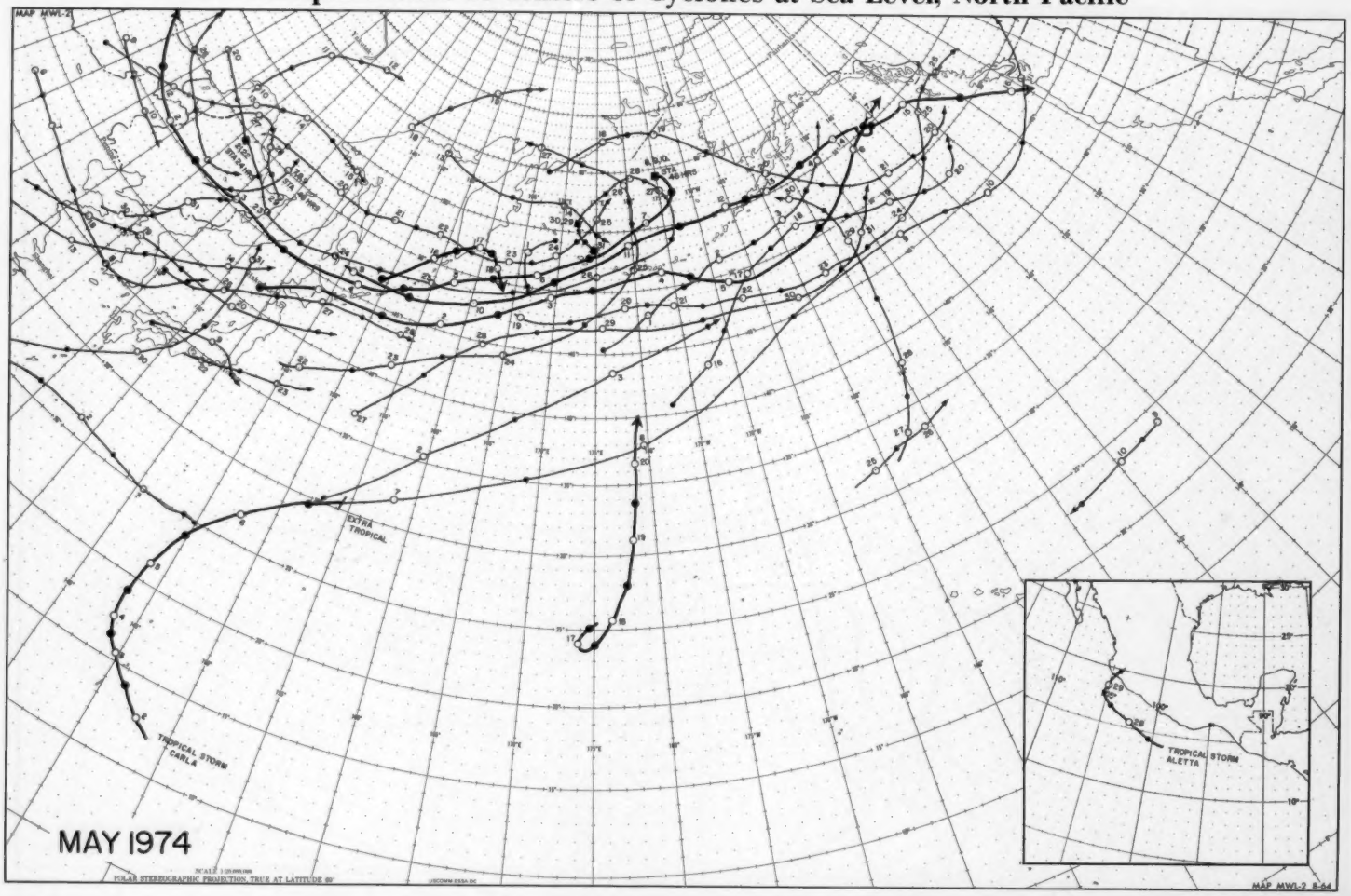


Figure 25.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

Figure 25. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

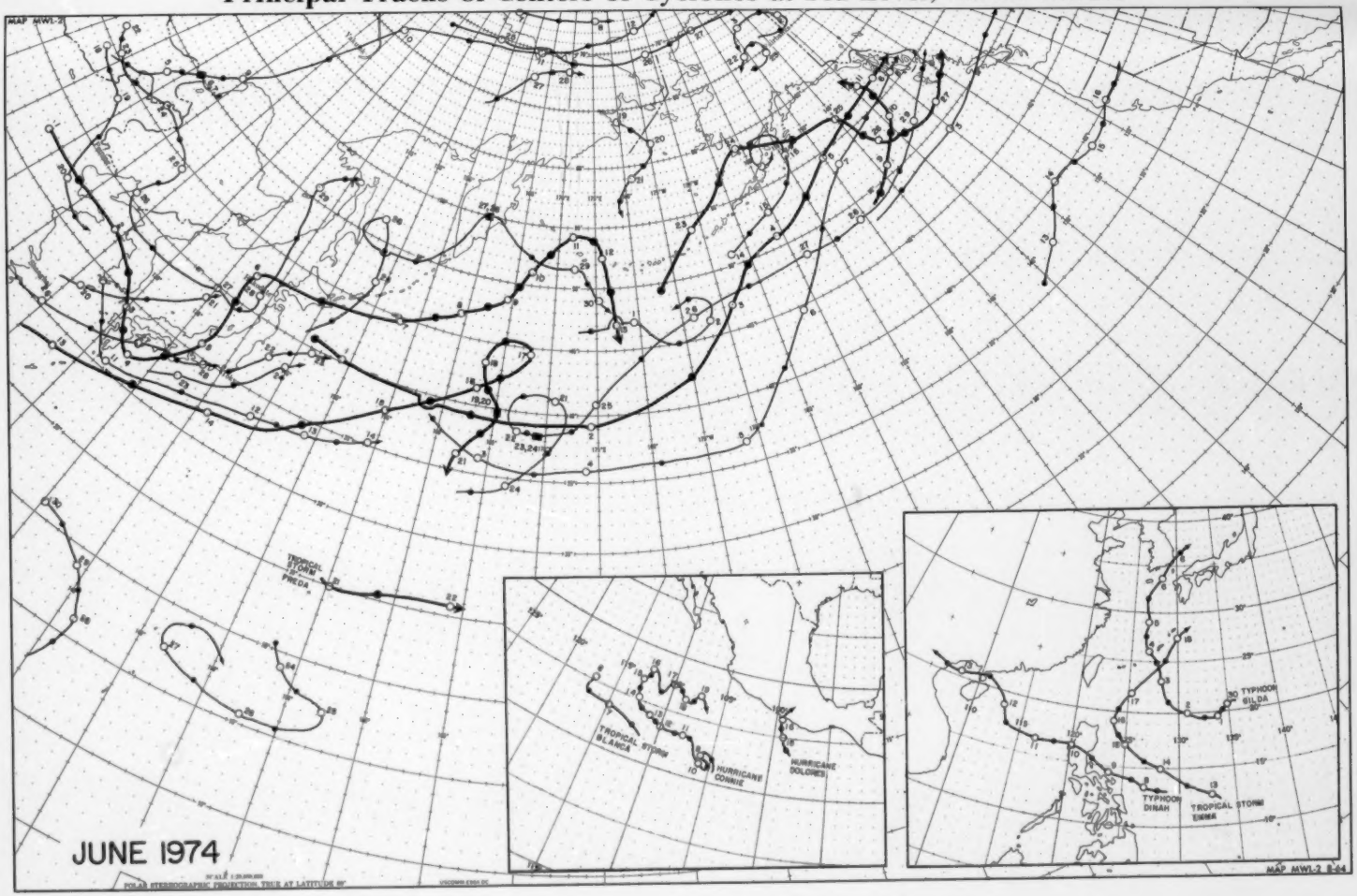


Figure 26. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 4

U.S. Ocean Station Vessel Climatological Data, North Atlantic

Ocean Weather Station 'BRAVO' 56°30'N 51°00'W **May and June, 1974**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
MAY	- .4	01 00	2.8	5.0	*14 15	- 5.8	01 09	.6	3.4	19 12	1.7	*14 12	3.5	4.4	*27 09	- 2.9	27 06	- .7	2.6	13 15
JUNE	1.9	01 12	5.0	7.8	10 09	- .8	01 00	3.4	6.4	21 13	3.3	14 06	4.5	5.7	26 15	- 2.2	*01 18	.8	3.9	10 09

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR PCPN	DREL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
MAY	992.0	18 15	1011.9	1027.6	26 21	3.8	.6	22.9	72.6	6.4	8.3	31.2	54.1	14	14	2	0	1	1	0	0	18	19.7	197
JUNE	994.5	02 12	1013.3	1027.2	18 21	3.7	6.2	10.5	77.6	11.9	8.1	18.1	61.9	13	13	1	0	10	1	0	0	26	14.9	210

** VV-90-93 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

MAY WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.5	3.5	10.4	6.7	1.3	.0	22.3	19.2
NE	1.0	4.8	12.9	2.7	.0	.0	22.3	12.5
E	.0	.8	9.2	1.8	.0	.0	5.8	17.5
SE	.6	1.3	3.8	2.7	.0	.0	8.4	17.1
S	.0	.8	1.0	.0	.0	.0	1.8	10.4
SW	.6	4.8	.0	.0	.0	.0	5.4	6.1
W	.6	6.4	3.5	.0	.0	.0	10.3	9.5
NW	.8	3.3	11.8	4.6	.0	.0	20.7	18.1
CALM	3.2	.0	.0	.0	.0	.0	3.2	.0
TOTAL	8.3	25.5	46.4	18.5	1.3	.0	100.0	14.2

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
197	010	36	07 2000	7.9	009	

JUNE WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	2.0	9.8	3.7	.0	.0	15.5	17.1
NE	.0	3.0	10.1	4.0	.5	.0	17.6	18.3
E	.0	1.9	8.3	4.0	.0	.0	14.2	19.0
SE	.5	4.0	4.3	.1	.0	.0	8.9	11.1
S	.0	8.1	6.1	.0	.0	.0	14.2	11.6
SW	.0	5.1	1.5	.0	.0	.0	6.7	8.9
W	.0	6.2	4.4	.0	.0	.0	10.6	10.6
NW	.0	1.7	8.0	4.3	.0	.0	11.9	19.0
CALM	.3	.0	.0	.0	.0	.0	.3	.0
TOTAL	1.0	30.0	50.5	18.1	.5	.0	100.0	13.2

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
210	030	37	24 1155	4.5	031	

Wave

MAY WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	8.3	5.9	7.2	.0	.0	.0	.0	21.3
NE	.0	8.4	12.6	2.9	.0	.0	.0	.0	23.9
E	.0	1.1	1.3	2.2	.0	.0	.0	.0	4.6
SE	.3	4.8	1.9	.3	.0	.0	.0	.0	7.0
S	.0	1.0	.0	.0	.0	.0	.0	.0	1.0
SW	.0	.0	.0	.0	.0	.0	.0	.0	.0
W	.0	2.9	3.2	.0	.0	.0	.0	.0	6.1
NW	.8	9.2	9.6	.2	.0	.0	.0	.0	19.8
IND	.0	12.1	3.8	.6	.0	.0	.0	.0	16.4
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.6	47.8	38.2	13.4	.0	.0	.0	.0	100.0

NUMBER OF OBS 197 IND=INDETERMINATE

JUNE WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	1.1	4.9	1.2	2.9	.0	.0	.0	9.4
NE	1.0	1.5	10.5	4.0	3.0	.0	.0	.0	20.0
E	.0	2.4	3.1	2.9	3.7	.0	.0	.0	12.0
SE	.0	5.5	2.1	.0	.0	.0	.0	.0	7.6
S	2.9	10.1	3.0	1.4	.0	.0	.0	.0	17.4
SW	.1	2.6	.0	.0	.0	.0	.0	.0	2.7
W	.8	4.9	.4	.0	.0	.0	.0	.0	6.1
NW	.0	4.8	4.8	.3	2.9	.0	.0	.0	12.9
IND	.5	7.1	2.9	1.4	.0	.0	.0	.0	11.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	5.2	40.0	31.0	11.4	12.4	.0	.0	.0	100.0

NUMBER OF OBS 210 IND=INDETERMINATE

MAY WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.6	28.0	13.4	.0	.0	.0	.0	.0	42.0
6-7	.0	7.6	21.0	12.7	.0	.0	.0	.0	41.4
8-9	.0	.0	.0	.0	.0	.0	.0	.0	.0
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	12.1	3.8	.6	.0	.0	.0	.0	16.4
TOTAL	.6	47.8	38.2	13.4	.0	.0	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE (DIR IN DEGREES)
197	4.5	6	010	SEA	07 15	

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

JUNE WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	2.9	17.6	9.5	.5	.0	.0	.0	.0	30.5
6-7	1.9	14.8	13.7	2.4	7.6	.0	.0	.0	42.4
8-9	.8	.3	2.9	6.7	4.8	.0	.0	.0	14.8
10-11	.0	.0	.0	.5	.0	.0	.0	.0	.5
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.5	7.1	2.9	1.4	.0	.0	.0	.0	11.9
TOTAL	5.2	40.0	31.0	11.4	12.4	.0	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE (DIR IN DEGREES)
210	5.0	9	030	SEA	24 13	

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 5
Selected Gale Observations, North Atlantic
May and June 1974

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10s	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves*: Period sec.	Sea Waves*: Height ft.	Swell Waves: Dir. 10s	Swell Waves: Period sec.*	Swell Waves: Height ft.
NORTH ATLANTIC		MAY															
MV RHINE ORE	LIBERIAN	1	44.9 N	23.1 W	18	25	35	2 NM	16	1003.4	14.0	12.0	7	16.5			
MV STOLT LLANDAFF	BRITISH	1	51.1 N	31.5 W	18	32	44	2 NM	02	1004.0	5.3	8.0			32	9	29.5
USCGC HAMILTON	AMERICAN	2	50.0 N	46.8 W	18	12	N 43	.5 NM	61	995.7	4.3	3.3	6	10			
SS ANCHORAGE	AMERICAN	2	40.2 N	64.3 W	12	32	40	10 NM	02	1016.3	10.6	17.7	7	6.5	32	10	14.5
MV FLEETBANK	BRITISH	2	42.8 N	09.5 W	18	28	39	10 NM	02	993.0	14.0	12.2	5	6.5	27	9	16.5
SS AMER ACCORD	AMERICAN	2	41.0 N	66.5 W	18	31	40	10 NM	02	1011.7	8.5	10.5	4	8	31	< 6	14.5
SS SEALAND MARKET	AMERICAN	2	47.3 N	21.9 W	12	34	45	5 NM	02	1006.4	11.1	12.2	10	24.5	34	>13	32.5
MV RHINE ORE	LIBERIAN	2	46.5 N	19.7 W	06	30	48	2 NM	18	998.3	8.0	12.0	9	26			
SS TEXACO MISSISSIPPI	AMERICAN	2	48.7 N	69.2 W	18	31	35	1 NM	70	1000.7	- 2.8	- 0.6	3	11.5	29	8	10
MV FLEETBANK	BRITISH	3	44.1 N	08.2 W	12	25	32	2 NM	62	990.2	12.2	12.4	10	19.5	27	10	32.5
MV NORDIC REGENT	NORWEGIAN	3	40.6 N	54.8 W	12	27	35	10 NM	03	1007.6	11.7	13.0	12	16.5			
SS LASH TURKIYE	AMERICAN	4	40.3 N	53.2 W	00	28	35	5 NM	07	1006.2	13.2	13.6	6	13			
MV STOLT LLANDAFF	BRITISH	4	43.9 N	43.6 W	12	23	38	10 NM	01	1008.6	6.0	7.0	4	8	23	6	14.5
SS EXPORT LEADER	AMERICAN	5	40.0 N	54.2 W	12	30	35	5 NM	32	1006.2	19.2	19.8	6	10	27	8	16.5
SS LASH TURKIYE	AMERICAN	5	40.5 N	61.4 W	00	27	40	5 NM	07	994.2	13.0	21.1	4	16.5	23	8	19.5
USCGC HAMILTON	AMERICAN	6	51.8 N	47.2 W	21	25	N 35	5 NM	02	988.3	4.3	3.3	5	11.5			
SS DEFIANCE	AMERICAN	6	38.7 N	65.7 W	12	10	35	5 NM	60	1012.0	12.8	11.7	5	8			
SS BALTIMORE TRADER	AMERICAN	6	40.7 N	69.2 W	18	09	38	5 NM	01	1005.0	10.0	7.8	3	8	09	X	10
MV NORDIC REGENT	NORWEGIAN	6	37.4 N	70.6 W	12	23	40	2 NM	07	1007.8	20.6	17.0	12	13			
SS PERRYVILLE	AMERICAN	6	29.0 N	79.6 W	18	23	35	50 YD	61	1011.5	18.9	23.6	5	10	27	8	6.5
MV BELMUDSON	BRITISH	7	45.5 N	40.8 W	06	25	N 42	10 NM	02	1019.5	9.0	13.5	5	14.5	23	8	24.5
USCGC HAMILTON	AMERICAN	7	53.0 N	48.1 W	03	32	N 40	5 NM	02	984.5	5.6	6.7	8	16.5			
SS EXXON BANGOR	AMERICAN	8	33.2 N	76.7 W	12	09	40	5 NM	28	1017.6	21.0	23.3	9	8.5			
MV ATLANTIC FOREST	NORWEGIAN	9	46.3 N	13.5 W	12	23	N 44	10 NM	02	995.0	11.9	13.0		13	25	X	19.5
SS CHEVRON FELUY	LIBERIAN	9	43.8 N	09.3 W	12	21	N 35	5 NM	02	1003.0	15.0	11.7	6	10	26	X	10
SS AMER LEGEND	AMERICAN	9	47.5 N	14.8 W	12	23	45	5 NM	18	989.3	10.0	11.1	4	10			
SS SEALAND MC LEAN	AMERICAN	9	46.8 N	28.4 W	12	32	35	10 NM	02	1016.0	11.7	10.7	5	10	30	< 6	16.5
SS AMER LEGEND	AMERICAN	10	47.0 N	17.4 W	00	29	40	5 NM	03	999.0	9.4	11.1	6	11.5			
SS AMER ACCORD	AMERICAN	10	39.5 N	60.3 W	12	04	35	5 NM	02	1013.5	17.0	22.3	4	6.5			
SS AMER ACCORD	AMERICAN	11	41.2 N	49.3 W	18	04	35	5 NM	02	1014.0	12.0	16.0	4	5			
SS AMER LEGEND	AMERICAN	11	44.6 N	30.0 W	12	32	40	5 NM	18	1001.0	11.7	11.7	5	11.5			
SS SOCONY VACUUM	AMERICAN	11	26.3 N	88.8 W	18	30	44	2 NM	07	1007.5	27.8	28.2	7	19.5			
SS EXPORT FREEDOM	AMERICAN	12	38.4 N	42.7 W	18	26	40	5 NM	01	999.2	16.7	18.4	3	16.5			
SS DELAWARE GETTY	AMERICAN	12	29.4 N	77.9 W	18	17	35	5 NM	03	1011.2	26.0	25.6	4	10			
SS AMER ACCORD	AMERICAN	12	42.8 N	49.7 W	12	05	35	5 NM	02	1005.4	11.0	13.0	4	5			
SS JULESBURG	AMERICAN	12	39.2 N	43.1 W	18	33	38	5 NM	07	994.6	16.2	17.3	7	11.5	25	>13	29.5
SS PERRYVILLE	AMERICAN	12	32.1 N	75.6 W	18	18	40	5 NM	03	1010.8	25.5	24.4	5	6.5	18	8	24.5
SS OCEANIC	PANAMANIAN	12	35.1 N	75.2 W	18	18	N 38	10 NM	03	1009.1	24.4	24.4	3	6.5			
SS AMER LYNX	AMERICAN	12	33.8 N	75.0 W	18	20	40	5 NM	02	1009.2	24.4	24.4	2	6.5	20	6	14.5
MV JAPANA	NORWEGIAN	13	50.0 N	16.1 W	00	27	40	10 NM	19	997.0	10.2	11.0	8	19.5			
SS JULESBURG	AMERICAN	13	40.2 N	41.7 W	00	32	42	5 NM	07	1002.4	12.3	17.3	7	10	32	6	26
MV SANDAR	NORWEGIAN	13	38.3 N	33.7 W	18	25	40	5 NM	80	999.0	17.0						
MV NORDLAND	SWEDISH	13	46.1 N	28.8 W	21	05	35	5 NM	02	1002.0	10.0	13.0		16.5	05	X	24.5
SS PERRYVILLE	AMERICAN	13	31.1 N	76.5 W	00	23	40	5 NM	18	1006.4	24.5	23.9	5	18	13	8	24.5
SS OCEANIC	PANAMANIAN	13	33.7 N	75.1 W	00	17	N 36	10 NM	25	1003.5	23.9	26.7	7	11.5			
SS GREAT REPUBLIC	AMERICAN	13	40.2 N	37.0 W	12	36	45	2 NM	62	994.9	14.0	15.6			36	6	11.5
SS EXPORT FREEDOM	AMERICAN	13	38.4 N	43.6 W	00	32	40	2 NM	07	1007.2	14.0	18.9	4	14.5			
MV ATLANTIC FOREST	NORWEGIAN	13	37.4 N	40.0 W	00	27	N 45	10 NM	02	1002.0	16.5			16.5	27	X	23
SS AMER ACCORD	AMERICAN	13	45.8 N	34.8 W	12	04	35	10 NM	02	1007.1	10.0	12.5	4	5			
SS AIMEE LYKES	AMERICAN	13	35.4 N	33.4 W	06	23	N 40	10 NM	02	1003.1	20.0	17.5			29	10	8
MV RUHR ORE	LIBERIAN	14	38.7 N	26.7 W	12	30	35	10 NM	02	1007.9	15.9	15.0					
SS SEALAND VENTURE	AMERICAN	14	45.0 N	36.2 W	00	02	N 36	10 NM	02	1013.2	9.4	13.3	4	6.5	02	8	13
SS ORE METEOR	LIBERIAN	14	35.8 N	22.1 W	12	20	35	10 NM	25	1012.6	17.5	17.3	4	8	28	6	13
SS AMER ACCORD	AMERICAN	14	47.9 N	28.6 W	12	02	45	5 NM	02	998.3	9.0	11.5	4	5			
MV JAPANA	NORWEGIAN	15	49.2 N	27.5 W	12	36	35	10 NM	02	1001.0	8.0	10.0	6	10			
SS SEALAND VENTURE	AMERICAN	15	39.7 N	45.6 W	00	33	N 38	10 NM	03	1014.6	17.8	17.2	5	8			
SS ADM W M CALLAGHAN	AMERICAN	15	45.0 N	38.8 W	18	37	45	5 NM	03	997.9	11.2	13.5	5	6.5	27	8	8
SS SEALAND MC LEAN	AMERICAN	16	45.8 N	39.9 W	00	30	40	10 NM	02	1010.0	11.7	15.0	5	8	30	< 6	13
MV FALSTRIA	DANISH	18	40.8 N	40.2 W	18	23	35	2 NM	16	998.3	18.4			8			
MV JAPANA	NORWEGIAN	18	41.0 N	55.0 W	12	31	47	5 NM	02	1003.9	11.5	16.0	8	16.5			
SS CHEVRON BRUSSELS	LIBERIAN	18	21.9 N	17.9 W	18	04	N 35	10 NM	01	1019.0	21.0	17.8	3	11.5			
SS AMER RANGER	AMERICAN	19	35.3 N	47.9 W	18	34	35	5 NM	21	1014.2	23.3	18.9	5	16.5	34	6	16.5
SS AMER ACE	AMERICAN	19	48.2 N	34.7 W	00	30	45	10 NM	29	982.1	13.3	12.2	5	10	25	< 6	6
BB DELTA SUD	AMERICAN	19	17.3 N	78.6 W	18	09	N 35	5 NM	02	1011.2	26.3	26.0			09	7	6.5
SS CHEVRON BRUSSELS	LIBERIAN	19	23.9 N	17.0 W	06	04	N 35	10 NM	02	1020.0	20.0	18.8	3	11.5			
SS GAGE LUND	LIBERIAN	20	15.7 N	78.8 W	12	09	36	5 NM	03	1012.5	27.0	26.7	4	8			
SS MARYLAND TRADER	AMERICAN	21	38.0 N	20.5 W	12	04	35	10 NM	03	1022.6	18.3	16.3	3	8	04	7	14.5
SS DELAWARE GETTY	AMERICAN	21	32.2 N	78.0 W	18	10	35	5 NM	03	1020.7	25.0	27.2	3	13			
USNS TALLULAH	AMERICAN	22	36.7 N	20.4 W	18	05	35	5 NM	03	1022.0	18.0	20.0	3	6.5	05	6	13
SS TUCURINCA	BRITISH	22	34.6 N	23.9 W	12	03	35	5 NM	02	1016.0	19.2	20.0	4	6.5	04	12	16.5
USNS TALLULAH	AMERICAN	23	36.9 N	22.3 W	12	07	35	10 NM	02	1022.0	17.3	19.4	3	6.5	04	6	18
SS LASH ESPANA	AMERICAN	24	41.1 N	50.7 W	06	07	N 35	5 NM	30	1016.9	10.0	13.6	5	10	07	7	13
SS EXXON JAMESTOWN	AMERICAN	27	37.0 N	70.6 W	18	18	40	2 NM	30	1001.2	22.9	23.3			18	8	16.5
MV HOEGH MERCHANT	NORWEGIAN	27	15.2 N	73.2 W	12	09	35	5 NM	03	1013.5	27.3	26.0	6	19.5			
SS ASHLEY LYKES	AMERICAN	28	36.7 N	20.3 W	18	36	35	5 NM	02	1007.6	14.5	19.3	6	8	02	11	14.5
SS TRANSHAWII	AMERICAN	28	36.1 N	72.2 W	06	30	35	5 NM	01	1012.5	17.8	25.0	3	6.5	33	6	13
SS AMER ACCORD	AMERICAN	28	40.5 N	59.3 W	18	24	45	5 NM	02	998.0	16.5	24.3			24	6	18
SS MARYLAND TRADER	AMERICAN	28	36.5 N	69.1 W	12	32	42	10 NM	02	1013.2	15.3	21.1	10	19.5			
MV MELVIN H BAKER	LIBERIAN	28	42.0 N	66.4 W	18	35	35	2 NM	80	1004.9	3.3	7.0			33	9	11.5
MV PRINCE OF FUNDY	SWEDISH	28	43.6 N	67.9 W	18	35	N 50	10 NM	01	1006.9	9.0	6.0					
SS ERIC H HOLZER	AMERICAN	28	38.6 N	72.8 W	00	02	45	5 NM	03	1007.8	14.0	23.9	10	16.5			
SS ASHLEY LYKES	AMERICAN	29	36.6 N	18.4 W	00	36	35	10 NM	02	1022.2	14.5	15.5	6	8	02	11	14.5
SS AMER ARCHER	AMERICAN	29	41.6 N	57.2 W	12	26	35	10 NM	02	998.0	10.6	19.4	7	6.5	29	7	10
SS AMER LEGACY	AMERICAN	29	41.2 N	61.0 W	12	31	35	10 NM	02	1003.8	10.0	17.3	3	19.5			
SS AUSTRAL PATRIOT	AMERICAN	29	34.9 N	38.2 W	12	29	35	10 NM	15	1013.5	22.8	19.4			29	6	14.5
SS AMER ACCORD	AMERICAN	29	40.2 N	60.7 W	00	28	50	2 NM	07	999.7	11.7	18.3			26	7	19.5
SS DEFIANCE	AMERICAN	29	38.8 N	57.7 W	18	31	38	5 NM	02	1008.8	18.4	21.8	8	19.5	31	9	24.5
SS TAMPA	AMERICAN	30	34.8 N	71.8 W	18	27	40	5 NM	05	1010.5	24.4	21.2			29	6	19.5
SS AUSTRAL PATRIOT	AMERICAN	30	37.2 N	65.0 W	12	25	35	1 NM	16	1007.1	22.8	20.0	6	19.5	26	11	24.5

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind			Visibility		Present Weather code	Pressure mb.	Temperature °C		Sea Waves+		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°		Speed kt.	n. mi.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.°	Height ft.
NORTH ATLANTIC OCEAN		MAY																	
SS CAVALA	LIBERIAN	30	35.0 N	74.7 W	12	24		35	5	NM	03	1010.0	25.5	27.2	4	13	24	7	16.5
SS EXPORT AIDE	AMERICAN	30	35.5 N	64.4 W	18	22		40	5	NM	03	1010.6	23.4	20.0	12	19.5			
MV VICENTE GUERRERO	MEXICAN	31	22.2 N	92.7 W	12	11		33	10	NM	03	1008.2	27.0	29.0			11	6	8
SS SEALAND VENTURE	AMERICAN	31	39.0 N	40.7 W	12	21	M	38	10	NM	01	1015.9	20.0	18.3	4	6.5	21	6	13
GREAT LAKES VESSELS																			
SS GEORGE D GOBLE	AMERICAN	1	45.6 N	84.0 W	12	30	M	35	10	NM	03		2.0	4.0	4	5			
SS ARTHUR M ANDERSON	AMERICAN	11	42.3 N	87.3 W	18	19	M	38	< 50	YD	47		8.0	4.0					
SS JOHN SHERWIN	AMERICAN	11	46.6 N	83.1 W	18	14	M	38	2	NM	30		0.0	2.0	5	5			
SS RESERVE	AMERICAN	11	47.3 N	86.3 W	18	10	M	38	5	NM	50		2.0	3.0	3	10			
SS JOHN DYKSTRA	AMERICAN	11	47.3 N	86.7 W	18	11	M	46	2	NM	05		2.0	2.0	7	13			
SS JOHN DYKSTRA	AMERICAN	12	46.8 N	85.0 W	00	14	M	37	2	NM	05		4.0	2.0	8	11.5			
SS PAUL H CARNAHAN	AMERICAN	13	43.3 N	82.4 W	18	26	M	37	10	NM	01		20.0	10.0	4	5			
NORTH ATLANTIC		JUNE																	
SS SEALAND VENTURE	AMERICAN	1	41.0 N	35.9 W	00	21	M	38	10	NM	02	1013.2	18.9	18.3	4	6.5	21	8	16.5
MV HOEGH MERCHANT	NORWEGIAN	3	52.8 N	18.0 W	18	27		35	5	NM	25	1014.0	11.0	10.0	10	19.5			
SS PERRYVILLE	AMERICAN	3	29.2 N	94.4 W	18	14		37	10	NM	03	1012.6	28.0	28.3	4	13	15	6	24
SS PRES JOHNSON	AMERICAN	5	13.0 N	78.0 W	06	05	M	35	10	NM	02	1010.5	26.7	27.3			05	7	8
SS ANCHORAGE	AMERICAN	6	37.7 N	58.4 W	18	24		35	2	NM	10	1017.8	26.1	23.8	4	8			
MV HOEGH MERCHANT	NORWEGIAN	6	53.5 N	18.0 W	00	27		37	5	NM	81	1010.3	8.0	10.5	6	23			
MV SAN FRANCISCO	SWEDISH	6	50.8 N	12.5 W	00	29		35	5	NM	25	1016.0	11.5	12.5	8	13			
USNS SAUGATUCK	AMERICAN	7	28.3 N	92.3 W	18	32		35	10	NM	02	1008.8	30.0	30.0	5	13			
SS TELA	HONDURAN	9	13.9 N	77.4 W	18	08		30	5	NM	01	1011.0	28.3	28.8			07	6	6.5
SS MARGARET LYKES	AMERICAN	10	30.5 N	11.7 W	18	01	M	45	5	NM	02	1011.7	16.1	15.6	7	18			
SS RED JACKET	AMERICAN	10	41.5 N	47.8 W	06	25		40	5	NM	02	1009.3	16.7	16.1	5	13			
MV LONG CHARITY	NORWEGIAN	11	40.6 N	41.2 W	06	20		34	2	NM	80	1003.0	17.5						
SS SEALAND VENTURE	AMERICAN	11	34.8 N	37.2 W	18	20	M	40	10	NM	02	1015.6	20.0	20.6	3	6.5	20	10	16.5
MV PERNDALE	NORWEGIAN	12	47.5 N	28.4 W	06	18		37	2	NM	07	1007.8	14.4		8	14.5			
SS L W FUNKHOUSER	LIBERIAN	14	43.5 N	09.6 W	18	05	M	36	5	NM	08	1008.5	16.0	13.0	10	5			
SS ROSE CITY	AMERICAN	17	36.5 N	72.5 W	00	18		35	5	NM	82	1009.1	24.2	27.2	8	10	XX	X	10
SS J T HIGGINS	LIBERIAN	21	21.2 N	17.8 W	06	30	M	35	5	NM	02	1019.0	18.0	18.9	5	8			
SS BOSTON	AMERICAN	22	34.8 N	74.7 W	12	22		35	5	NM	03	1006.4	26.7	26.2	5	14.5			
MV DONA CORAZON II	PHILIPPINE	25	31.3 N	74.9 W	12	22	M	37	2	NM	02	1008.9	25.0	27.0	5	8			
SS EXXON WASHINGTON	AMERICAN	25	30.4 N	79.6 W	18	29		38	2	NM	15	1005.5	26.5	28.4	13	19.5			
SS CORONADO	AMERICAN	25	30.8 N	73.0 W	18	20		35	10	NM	03	1015.6	26.7	25.5	8	11.5	19	10	14.5
SS CORONADO	AMERICAN	26	32.3 N	73.6 W	00	23		30	5	NM	05	1013.9	25.5	25.0	10	16.5			
SS MOBIL AERO	AMERICAN	26	25.2 N	84.5 W	06	13		35	5	NM	97	1007.6	23.9	25.6	3	10	12	7	14.5
SS SOCONY VACUUM	AMERICAN	26	25.0 N	84.5 W	18	15		35	2	NM	02	1007.8	26.8	27.8	5	10	15	8	13
SS ORE CHIEF	LIBERIAN	26	34.8 N	72.0 W	00	24		35	5	NM	51	1010.8	24.8	27.3	4	5	21	8	10
SS SYLVO	NORWEGIAN	26	33.9 N	72.4 W	00	25		38	200	YD	65	1010.5	22.0	23.0	8	14.5			
SS SEALAND VENTURE	AMERICAN	26	36.1 N	68.9 W	00	20		40	5	NM	02	1001.0	25.6	28.3	8	6.5	20	8	10
SS BOSTON	AMERICAN	26	32.4 N	73.1 W	00	25		45	2	NM	02	1010.5	27.8	26.2	5	18			
SS VALLEY FORGE	AMERICAN	27	26.2 N	76.8 W	06	18		35	5	NM	02	1011.0	27.2	26.7	4	8	21	6	6.5
SS TRANSHAWII	AMERICAN	28	36.2 N	72.2 W	12	11		36	1	NM	52	1012.7	22.2	23.0	4	10			
OCEAN STATION VESSELS																			
ATLANTIC B																			
USCGC MORGENTHAU	AMERICAN	24	36.5 N	51.0 W	12	03	M	37	1	NM	61	1008.1	5.4	4.4	7	14.5			
GREAT LAKES VESSELS																			
SS JOHN DYKSTRA	AMERICAN	8	47.1 N	85.8 W	00	12	M	36	30	YD	45		8.0	2.0	6	5			
SS WILLIAM A IRVIN	AMERICAN	10	47.6 N	87.4 W	12	03	M	36	2	NM	83		5.0	4.0	8	6.5			
SS ASHLAND	AMERICAN	10	47.3 N	88.6 W	12	03	M	44	2	NM	05		5.0	4.0	8	14.5			
SS LEON FALK JR	AMERICAN	11	43.9 N	82.7 W	06	28	M	38	> 25	NM	02		14.0	18.0	6	8			
SS WILLIAM A IRVIN	AMERICAN	23	42.4 N	87.2 W	00	01	M	39	> 25	NM	02		14.0	13.0	6	8			

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Table 6

U.S. Ocean Station Vessel Climatological Data, North Pacific

Ocean Weather Station 'NOVEMBER' 30°00'N 140°00'W — **May and June, 1974**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
MAY	15.8	17 12	18.7	23.0	24 00	8.8	09 00	13.5	17.4	09 06	13.6	17 12	15.5	21.3	29 00	- 2.9	09 06	- 1.0	1.8	24 00
JUNE	17.0	20 12	19.5	22.8	27 18	9.7	13 18	14.3	17.5	05 06	15.8	14 00	20.2	22.8	29 06	- 3.5	23 06	- .7	2.4	29 00

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR DRZL PCPN	DRZL	SNOW	TSTM	VISY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
MAY	1020.1	30 12	1025.2	1030.7	18 18	19.4	21.8	42.7	16.1	28.2	28.6	29.8	13.3	11	11	0	0	0	0	0	0	0	8.4	124
JUNE	1012.7	13 00	1023.6	1030.8	05 18	20.5	6.3	48.4	24.8	23.0	7.1	41.1	28.8	10	10	0	0	0	0	0	0	0	9.4	112

** VV-90-93 AND/OR 9-4 COMP OB DAYS-COMPLETE OB DAYS

Wind

MAY — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.8	5.6	.0	.0	.0	6.4	16.9
NE	.0	7.1	11.5	3.0	.0	.0	21.6	14.9
E	.0	12.5	10.9	2.4	.0	.0	25.8	13.2
SE	.0	6.3	9.9	.8	.0	.0	16.1	12.0
S	.0	5.8	1.4	.8	.0	.0	7.3	8.2
SW	.0	3.0	.7	.0	.0	.0	3.2	6.3
W	.8	3.0	.8	.0	.0	.0	3.8	9.6
NW	.0	1.0	.8	.0	.0	.0	1.0	9.0
CALM	8.9	.0	.0	.0	.0	.0	8.9	.0
TOTAL	9.7	39.5	49.2	9.4	.0	.0	100.0	11.8

NUMBER OF OBS 124 — MAX WIND SPED 27 DIR 070 DA HR 10 0000 — VECTOR SPEED 8.0 — MEAN DIR 079 — (DIR IN DEGREES)

JUNE — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.0	3.6	.0	.0	.0	3.6	13.8
NE	2.0	8.5	21.9	8.7	.0	.0	41.1	13.0
E	.7	5.1	15.4	2.9	.0	.0	24.1	14.0
SE	.0	3.4	1.1	.0	.0	.0	4.5	8.3
S	.0	.7	.7	.0	.0	.0	1.3	9.5
SW	.0	.0	1.1	.0	.0	.0	1.1	14.0
W	.0	.7	.7	.0	.0	.0	1.3	12.5
NW	.0	.2	3.6	.0	.0	.0	4.0	14.5
CALM	17.0	.0	.0	.0	.0	.0	17.0	.0
TOTAL	19.6	20.5	48.2	11.6	.0	.0	100.0	12.6

NUMBER OF OBS 112 — MAX WIND DIR 060 SPEED 28 DA HR 08 0600 — VECTOR SPEED 9.6 — MEAN DIR 057 — (DIR IN DEGREES)

Wave

MAY — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	1.4	2.8	.8	.0	.0	.0	.0	5.0
NE	1.0	8.5	6.3	.6	.0	.0	.0	.0	16.3
E	.8	12.9	6.0	1.8	.0	.0	.0	.0	21.4
SE	1.6	12.5	.0	.0	.0	.0	.0	.0	14.1
S	2.2	1.6	.0	.0	.0	.0	.0	.0	3.8
SW	1.0	.0	.0	.0	.0	.0	.0	.0	1.0
W	.0	2.2	.0	.0	.0	.0	.0	.0	2.2
NW	.0	9.3	1.8	.0	.0	.0	.0	.0	11.1
IND	2.4	22.6	.0	.0	.0	.0	.0	.0	25.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	8.9	71.0	16.9	3.2	.0	.0	.0	.0	100.0

NUMBER OF OBS 124 — IND=INDETERMINATE

JUNE — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	8.5	.9	.0	.0	.0	.0	.0	9.4
NE	.0	23.9	6.9	7.4	.0	.0	.0	.0	38.2
E	1.8	14.3	8.3	.7	.0	.0	.0	.0	24.8
SE	2.2	4.9	.0	.0	.0	.0	.0	.0	7.1
S	.7	1.6	.0	.0	.0	.0	.0	.0	2.2
SW	.9	1.1	.0	.0	.0	.0	.0	.0	1.1
W	.0	.0	.7	.0	.0	.0	.0	.0	.7
NW	.0	4.7	2.0	.0	.0	.0	.0	.0	6.7
IND	1.8	8.8	.0	.0	.0	.0	.0	.0	9.8
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	8.3	67.0	18.8	8.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 112 — IND=INDETERMINATE

MAY — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	6.5	27.4	1.6	.0	.0	.0	.0	.0	35.5
6-7	.0	12.1	13.7	3.2	.0	.0	.0	.0	29.0
8-9	.0	7.3	.0	.0	.0	.0	.0	.0	7.3
10-11	.0	1.6	1.6	.0	.0	.0	.0	.0	3.2
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	2.4	22.6	.0	.0	.0	.0	.0	.0	25.0
TOTAL	8.9	71.0	16.9	3.2	.0	.0	.0	.0	100.0

NUMBER OF OBS 124 — MAX WAVE HEIGHT HGT 3.0 PER 6 DIR 070 TYPE SEA DA HR 10 00 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

JUNE — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	4.5	23.2	6.0	.9	.0	.0	.0	.0	34.6
6-7	.0	6.3	9.8	7.1	.0	.0	.0	.0	23.2
8-9	.0	19.6	.9	.0	.0	.0	.0	.0	20.5
10-11	.0	9.8	.0	.0	.0	.0	.0	.0	9.8
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	1.8	8.0	.0	.0	.0	.0	.0	.0	9.8
TOTAL	6.3	67.0	16.8	8.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 112 — MAX WAVE HEIGHT HGT 3.0 PER 6 DIR 070 TYPE SEA DA HR 07 12 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 7
Selected Gale Observations, North Pacific
May and June 1974

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves?		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC		MAY															
MV EASTERN CHERRY	LIBERIAN	1	43.1 N	169.5 E	06	31	37	10 NM	03	1001.9	8.0	4.0	9	14.5	23	7	11.5
MV EASTERN OCEAN	LIBERIAN	1	45.6 N	178.4 W	18	29 M	40	5 NM	03	991.8	5.0	6.5			28	9	19.5
SS HOEGH TRANSPORTER	NORWEGIAN	1	38.5 N	179.4 W	06	20	35	2 NM	30	1007.0	14.0	14.0	5	8			
SS J H TUTTLE	AMERICAN	1	49.5 N	141.3 W	00	29	35	5 NM		1009.3	6.7	6.1			27	7	11.5
SS PRES MCKINLEY (NEW)	AMERICAN	1	30.0 N	129.0 E	06	02	40	5 NM	30	1008.1	16.7	19.4	5	8			
MV ATLANTIC PHOENIX	BRITISH	2	42.1 N	177.2 W	12	30	35	10 NM	02	1013.0	7.0	8.0	8	11.5			
SS WALTER RICE	AMERICAN	2	38.3 N	123.9 W	12	32	48	10 NM	03	1017.8	12.0	7.8			32	8	14.5
SS WASHINGTON MAIL	AMERICAN	2	43.9 N	167.8 W	12	27	40	10 NM	18	1001.0	7.2	8.3	6	16.5	27	8	24.5
MV EASTERN CHERRY	LIBERIAN	2	45.4 N	179.0 E	12	32	35	10 NM	03	1012.0	4.3	4.0	8	13	29	8	13
MV EASTERN OCEAN	LIBERIAN	2	46.6 N	174.1 W	06	30 M	40	1 NM	30	993.6	4.5	7.0			29	9	19.5
MV NORBROTT	NORWEGIAN	2	32.5 N	158.6 E	12	20	35	1 NM	10	1001.0	21.0	18.0	5	8			
MV NORTH STAR III	AMERICAN	2	54.2 N	165.7 W	12	09 M	40	1 NM	64	991.9	2.8	3.3					
SS WALTER RICE	AMERICAN	3	41.5 N	124.9 W	06	34	55	10 NM	02	1020.2	14.2	7.7			35	< 6	14.5
MV EMMA JOHANNA	GERMAN	3	39.8 N	168.9 E	18	28	37	10 NM	02	1007.0	9.0	11.4			XX	X	13
SS LONG LINES	AMERICAN	3	44.4 N	168.5 E	18	28 M	36	5 NM	02	994.9	3.8	1.7	7	11.5			
SS HOEGH TRANSPORTER	NORWEGIAN	3	36.7 N	166.0 E	06	28	35	2 NM	10	1002.0	15.0	16.0	5	6.5	23	9	11.5
SS PHILLIPS OKLAHOMA	LIBERIAN	3	37.9 N	172.9 E	12	27	48	2 NM	51	1005.0	12.8	13.9	8	14.5	23	10	14.5
MV VAN TRIUMPH	LIBERIAN	4	44.2 N	147.5 W	06	20 M	38	5 NM	02	1010.0	10.0	8.0					
MV EMMA JOHANNA	GERMAN	4	40.4 N	178.8 E	12	28	40	10 NM	02	1012.2	8.3	11.0	8	13			
MV KYOJU MARU	JAPANESE	4	30.5 N	139.8 W	06	15 M	35	.5 NM		1015.0	9.0	3.0	4	5			
SS LONG LINES	AMERICAN	4	45.1 N	172.8 E	12	27 M	40	5 NM	02	996.3	4.4	0.0	10	14.5			
MV REGENT VANDA	PANAMANIAN	4	45.2 N	176.8 W	12	24 M	39	5 NM	03	990.0	7.0	6.0					
SS PHILLIPS OKLAHOMA	LIBERIAN	4	38.0 N	180.0 W	18	30	36	5 NM	03	1018.0	10.6	13.9	6	10	30	8	13
MV EMMA JOHANNA	GERMAN	5	40.8 N	178.4 E	03	29	46	10 NM	02	1016.0	9.8	10.0	8	14.5	26	8	23
SS PHILLIPS OKLAHOMA	LIBERIAN	5	38.5 N	177.8 W	06	32	43	10 NM	03	1020.0	10.0	13.3	8	13	31	10	16.5
SS PRES MCKINLEY (NEW)	AMERICAN	5	36.3 N	144.7 E	06	20	35	10 NM	02	1005.1	19.4	19.4	6	8	20	7	11.5
SS JAPAN MAIL	AMERICAN	5	38.5 N	172.1 W	18	34	40	10 NM	03	1020.0	11.2	11.7	4	10	25	9	14.5
SS HOEGH TRANSPORTER	NORWEGIAN	5	35.2 N	147.6 E	18	30	35	5 NM	02	1003.0	17.0	16.0					
SS GOLDEN EXPLORER	LIBERIAN	6	51.5 N	172.0 E	18	22 M	40	2 NM	80	973.2	4.0	4.0			22	7	16.5
SS SEALAND GALLOWAY	AMERICAN	6	24.9 N	120.4 E	06	02	35	5 NM	02	1004.8	20.6	21.7	4	6.5	03	7	5
MV KYOJU MARU	JAPANESE	6	32.1 N	167.0 W	00	26 M	36	5 NM	02	988.0	6.0	2.0	6	6.5	23	8	14.5
SS ARCO ANCHORAGE	AMERICAN	6	40.4 N	180.5 W	00	28	35	10 NM	02	1014.9	11.2	10.5			26	9	19.5
SS GOLDEN EXPLORER	LIBERIAN	7	51.0 N	170.2 E	00	33 M	38	2 NM	01	976.6	3.8	4.0	5	8	32	7	19.5
SS SEALAND RESOURCE	AMERICAN	7	32.1 N	149.3 W	06	28	35	5 NM	03	1000.5	5.3	5.0	6	10			
SS PRES TAFT /NEW/	AMERICAN	7	52.5 N	176.4 E	18	31	50	5 NM	15	982.5	4.4	2.2	3	14.5	29	8	13
MV NORTH STAR III	AMERICAN	7	52.2 N	174.2 W	12	23 M	40	1 NM	03	976.0	2.8	3.0	5	8			
SS ARCTIC TOKYO	LIBERIAN	8	54.1 N	170.8 W	12	27 M	38	10 NM	25	986.0	8.0	3.0	15	16.5			
USCGC JARVIS	AMERICAN	8	54.1 N	166.8 W	12	24 M	35	5 NM	02	992.0	5.5	4.4	3	5	26	7	8
SS SEALAND RESOURCE	AMERICAN	8	54.3 N	168.0 W	12	27	35	5 NM	02	990.4	3.7	3.3	5	10			
SS EXPORT COURIER	AMERICAN	8	35.1 N	137.6 W	18	18 M	38	5 NM	02	1022.0	14.0	13.7	4	5	32	8	6.5
SS PRES TAFT /NEW/	AMERICAN	8	52.1 N	175.4 E	00	31	45	10 NM	15	994.2	1.7	2.2	5	10	34	7	16.5
MV NORTH STAR III	AMERICAN	8	52.2 N	174.2 W	06	27 M	45	5 NM	26	988.0	2.8	4.4	3	5			
SS ARCTIC TOKYO	LIBERIAN	9	53.8 N	179.0 E	12	18 M	40	2 NM	26	1000.0	7.3	3.0	10	13			
SS SEALAND RESOURCE	AMERICAN	9	52.9 N	177.7 E	12	29	35	5 NM	26	1001.9	1.1	2.3	5	11.5			
SS GOLDEN EXPLORER	LIBERIAN	9	44.2 N	153.1 E	12	18 M	38	2 NM	10	1007.5	6.0	2.0	3	10	18	8	19.5
SS PRES TAFT /NEW/	AMERICAN	9	50.4 N	163.5 E	00	23	35	5 NM	26	1007.1	2.2	1.7	7	11.5	02	10	11.5
SS ARCTIC TOKYO	LIBERIAN	10	53.3 N	174.6 E	00	29 M	39	10 NM	02	1012.0	4.5	3.0	10	11.5			
MV VAN TRIUMPH	LIBERIAN	10	41.4 N	169.9 E	18	20 M	41	2 NM	81	1008.0	12.5	10.0					
SS HAWAII	AMERICAN	10	48.8 N	178.7 E	18	19	37	2 NM	51	1008.5	6.7	5.0	7	10			
MV MONTIRON	LIBERIAN	10	39.0 N	161.5 E	12	20 M	35	2 NM	61	1000.9	15.0	11.2	7	13			
SS ALASKAN MAIL	AMERICAN	11	52.2 N	174.5 E	18	36	40	2 NM	02	991.0	2.8	2.2	5	11.5	XX	X	10.5
MV VAN TRIUMPH	LIBERIAN	11	40.9 N	165.2 E	12	29 M	35	5 NM	02	1020.0	10.0	8.0					
MV VAN ENTERPRISE	LIBERIAN	11	52.3 N	162.9 W	14	18 M	37	5 NM	21	994.0	5.0	3.0			18	< 6	10
SS TOWER BRIDGE	SINGAPORE	11	51.8 N	165.0 W	12	21 M	37	2 NM	81	1005.0	5.0	7.0	5	16.5	26	6	11.5
MV TOYOTA MARU # 10	JAPANESE	11	47.3 N	169.8 W	18	20 M	40	2 NM	81	1001.9	7.3	6.3	6	13			
SS HAWAII	AMERICAN	11	47.0 N	178.7 E	06	24	45	2 NM	12	994.5	6.6	5.0	7	11.5	22	7	19.5
MV EASTERN BUILDER	LIBERIAN	11	51.3 N	164.0 W	18	19 M	42	1 NM	81	995.0	6.0	6.0	6	8	18	8	18
MV HONSHU MARU	JAPANESE	11	50.8 N	177.5 W	18	23 M	36	.5 NM	65	972.5	4.0	3.3			23	12	21
MV MIDAS RHEIN	LIBERIAN	11	47.6 N	178.1 W	06	19 M	34	.25 NM	63	1000.0	7.1	4.0	6	11.5	21	11	23
MV NORTH STAR III	AMERICAN	11	56.1 N	161.9 W	18	14 M	35	10 NM	02	999.7	1.1	0.8	3	10			
SS ALASKAN MAIL	AMERICAN	12	51.6 N	172.8 E	00	36	40	5 NM	02	1000.0	6.1	3.9	4	10			
SS AMER MAIL	AMERICAN	12	53.4 N	175.6 W	18	27	45	5 NM	68	979.3	5.0	3.3	7	11.5	26	8	36
MV TOYOTA MARU # 10	JAPANESE	12	48.9 N	165.4 W	06	26 M	40	5 NM	02	995.0	6.5	4.5	9	16.5			
MV NORTH STAR III	AMERICAN	12	52.9 N	180.4 W	12	29 M	35	5 NM	03	984.1	2.2	2.2					
MV MIDAS RHEIN	LIBERIAN	12	48.5 N	172.0 W	00	25 M	37	.5 NM		993.8	5.0	4.0	7	13	24	12	23
MV EASTERN BUILDER	LIBERIAN	12	49.4 N	166.2 W	18	27 M	41	5 NM	03	993.5	4.0	6.0	6	10	27	8	18
SS HAWAII	AMERICAN	12	45.3 N	178.0 W	00	27	38	10 NM	01	1008.5	5.6	6.6	6	10	27	8	13
MV HONSHU MARU	JAPANESE	12	50.8 N	178.1 W	00	29 M	40	1 NM		982.5	4.0	4.0	6	8	27	6	10.5
SS TRANSINDIANA	AMERICAN	12	40.4 N	174.3 W	12	27	35	10 NM	02	1004.4	4.4	3.0	5	8	27	10	19.5
MV VAN ENTERPRISE	LIBERIAN	12	51.8 N	167.3 W	12	23 M	42	5 NM	20	980.0	5.0	4.0			10	23	6	20
SS JAPAN BEAR	AMERICAN	13	48.0 N	138.0 W	12	23 M	36	5 NM	02	1004.0	7.2	7.8	6	10	32	8	16.5
MV MIDAS RHEIN	LIBERIAN	13	49.3 N	156.6 W	12	25 M	40	2 NM	00	1002.8	4.3	4.0	5	6.5	26	>13	16.5
SS HAWAII	AMERICAN	13	46.7 N	164.1 W	06	27	35	10 NM	02	1008.8	8.9	6.7	8	10	27	8	13
MV EASTERN BUILDER	LIBERIAN	13	48.5 N	169.0 W	12	27 M	43	2 NM	50	1006.0	5.0	5.0	6	10	26	6	19.5
SS AMER MAIL	AMERICAN	13	52.9 N	178.5 E	12	34	48	5 NM	68	1006.5	3.9	3.3	6	11.5	34	6	36
MV VAN ENTERPRISE	LIBERIAN	13	51.3 N	171.5 W	12	23 M	37	5 NM	25	996.0	7.0	3.0		10	25	6	26
MV TRIUMPH	PANAMANIAN	13	52.2 N	154.0 W	06	26 M	38	5 NM	15	989.0	3.0	7.0	6	6.5	26	12	16.5
MV WAY WAY	LIBERIAN	13	51.5 N	142.3 W	12	28 M	43	1 NM	80	998.9	7.5 - 0.6				27	8	
SS TRANSINDIANA	AMERICAN	13	46.3 N	176.4 W	00	28	35	10 NM	18	1011.9	8.3	5.0	5	8	28	9	19.5
MV TORINITA	NORWEGIAN	13	30.6 N	154.2 E	12	07	35	5 NM	25	1025.0	16.0	17.0		19.5			
SS SUMMIT	AMERICAN	14	53.2 N	171.5 W	06	30	35	10 NM	01	1010.0	4.4	3.9	3	6.5	30	8	11.5
MV MIDAS RHEIN	LIBERIAN	14	49.4 N	132.9 W	00	23 M	42	5 NM	02	1006.8	8.0	4.0	5	6.5	26	>13	16.5
MV EASTERN BUILDER	LIBERIAN	14	47.6 N	170.1 W	00	27 M	38	10 NM	01	1017.0	7.0	7.0			29	7	16.5
SS HAWAIIAN PROGRESS	AMERICAN	14	33.3 N	122.5 W	06	02	35	10 NM	02	1018.6	12.2	13.9	3	10	33	13	11.5
SS HAWAII	AMERICAN	14	47.7 N	152.9 W	06	26	35	10 NM	02	1012.5	9.5	6.7	8	8	26	8	13
MV TORINITA	NORWEGIAN	14	28.7 N	158.0 E	06	07	35	5 NM	25	1020.0	20.0	22.0	XX	19.5			
MV WAY WAY	LIBERIAN	14	52.5 N	146.6 W	06	25 M	35	10 NM	80	998.7	8.0 - 0.8						
MV ORIENTAL DESTINY	LIBERIAN	15	34.2 N	177.8 E	06	36	35	10 NM	03	1019.3	12.3	15.6	5	16.5	36	13	23
MV MIDAS RHEIN	LIBERIAN	15	48.4 N	144.9 W	00	28 M	35	10 NM	01	1016.5	8.0	4.0	5	6.5	27	>13	16.5

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves*			Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10's	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10's	Period sec.*	Height ft.
NORTH PACIFIC OCEAN		MAY																
MV LEDA MAERSK	DANISH	15	35.5 N	145.0 E	18	18	35	5 NM	02	1016.0	20.2	22.0						
SS HAWAII BEAR	AMERICAN	15	28.0 N	172.0 E	18	02	45	10 NM	02	1017.4	17.8	23.9		16.5	02	X	24.5	
MV VAN ENTERPRISE	LIBERIAN	15	49.6 N	179.2 E	00	22	M 35	10 NM	02	1023.6	8.0	9.0			22	< 6	6.5	
MV LEDA MAERSK	DANISH	16	35.7 N	148.8 E	00	18	35	2 NM	02	1018.5	18.0	19.0						
MV KRONOLAND	SWEDISH	16	31.8 N	176.8 E	18	03	M 35	> 25 NM	02	1020.0	15.0			13	03	X	23	
SS HAWAII BEAR	AMERICAN	16	28.4 N	174.3 E	12	05	50	5 NM	60	1014.6	17.8	23.3			05	X	32.5	
SS EXPORT COURIER	AMERICAN	16	38.5 N	158.2 E	12	18	M 40	5 NM	07	1024.0	13.0	17.2	3	6.5				
SS AMER MAIL	AMERICAN	16	45.8 N	155.3 E	06	20	47	2 NM	65	999.7	6.1	3.9	5	29.5	20	12	34.5	
SS SEALAND COMMERCE	AMERICAN	16	39.5 N	178.3 W	12	32	35	5 NM	02	1022.0	9.4	9.4						
SS WASHINGTON MAIL	AMERICAN	16	40.0 N	179.9 W	12	32	35	10 NM	02	1023.2	9.5	12.2	6	8	32	8	19.5	
MV TORINITA	NORWEGIAN	16	24.1 N	171.2 E	06	03	35	10 NM	25	1011.0	22.0	24.0	8	19.5				
SS UNIVERSE CONVEYOR	LIBERIAN	16	29.4 N	171.2 E	18	05	35	10 NM	03	1016.8	17.5	20.5	4	11.5	05	6	16.5	
SS TRANSINDIANA	AMERICAN	16	41.9 N	157.0 E	06	20	40	5 NM	63	1015.0	9.5	8.2	6	16.5	20	7	19.5	
SS UNIVERSE CONVEYOR	LIBERIAN	17	28.6 N	175.6 E	18	05	40	10 NM	80	1006.7	22.0	21.1	4	13	09	6	16.5	
MV WORLD PRIDE	LIBERIAN	17	49.6 N	162.6 W	00	13	M 40	5 NM	81	1023.5	7.5	6.0	5	8	14	8	10	
SS SEALAND GALLOWAY	AMERICAN	17	30.2 N	136.3 W	06	01	35	10 NM	02	1025.0	5.6	6.7	3	6.5				
MV NORMANNIA	GERMAN	17	32.7 N	177.6 W	18	08	37	2 NM	00	1019.3	16.3	18.3	5	10	04	9	13	
MV KRONOLAND	SWEDISH	17	31.9 N	177.7 W	18	07	M 35	10 NM	02	1018.0	19.0			13	07	X	23	
SS MONTANA	AMERICAN	17	28.5 N	168.9 E	06	03	35	10 NM	02	1018.0	18.3	22.2	4	5	03	7	10	
MV CHRYSANTEMA	BRITISH	17	28.5 N	165.3 E	06	06	40	10 NM	02	1019.0	20.0		5	8	06	8	19.5	
SS HAWAII BEAR	AMERICAN	17	29.6 N	178.3 E	12	06	50	5 NM	62	1011.5	18.9	22.2			06	X	32.5	
SS GUAM BEAR	AMERICAN	17	24.8 N	173.8 E	06	11	65	1 NM	92	994.9	21.1	23.9	4	16.5	05	>13	19.5	
SS NORTHERLY TRADER	LIBERIAN	20	50.3 N	152.7 W	18	32	M 35	200 YD	58	1012.0	5.0							
SS HARRY LUNDEBERG	PANAMANIAN	20	26.2 N	113.6 W	12	34	35	10 NM	00	1013.5	13.4	15.6	5	6.5	32	6	10	
SS GUAM BEAR	AMERICAN	20	17.4 N	134.3 E	12	16	30	1 NM	13	1005.1	25.6	27.8	6	19.5				
MV VAN ENTERPRISE	LIBERIAN	21	34.5 N	138.5 E	06	23	M 38	5 NM	21	1007.0	22.0	20.0			23	10	6.5	
SS TRANSONYX	PANAMANIAN	21	40.0 N	146.1 E	00	23	42	1 NM	51	1003.0	13.5	9.0			23	7	8	
MV WAY WAY	LIBERIAN	21	45.1 N	153.6 E	12	18	M 40	2 NM	60	1001.0	7.8	- 0.5						
SS GUAM BEAR	AMERICAN	21	16.7 N	153.5 E	00	23	35	10 NM	02	1009.5	25.6	27.2	6	13	XX	X	19.5	
MV MARGARET CORD	DANISH	22	40.5 N	177.0 W	06	27	40	10 NM	01	1011.5	10.5	11.0	3	11.5	27	10	13	
MV NORMANNIA	GERMAN	22	35.9 N	147.6 E	12	21	37	2 NM	62	1006.3	18.3	20.2	5	10	24	7	11.5	
SS PRES HARRISON	AMERICAN	23	41.4 N	172.3 W	06	31	35	10 NM	02	1013.9	8.9	9.4	7	16.5				
SS ORIENTAL EXPRESS	LIBERIAN	24	38.3 N	160.7 E	06	23	35	2 NM	21	1008.1	13.5	16.7	6	6.5	22	6	10	
SS ORIENTAL EXPRESS	LIBERIAN	25	37.1 N	153.2 E	06	23	35	1 NM	40	1012.5	19.4	18.3	5	5	24	6	10	
SS P S BRYANT	AMERICAN	27	41.2 N	125.3 W	12	33	35	10 NM	01	1016.0	13.8	13.3	5	5				
SS TEXAN	AMERICAN	28	17.7 N	102.6 W	06	23	35 (A)	5 NM	13	1012.0	28.9	29.4			18	8	16.5	
MV KORDTAN	YUGOSLAV	28	40.8 N	124.7 W	06	01	37	10 NM	01	1016.0	12.0	14.0	6	8				
SS PRES PIERCE	AMERICAN	28	37.6 N	127.2 W	12	36	M 40	10 NM	03	1017.0	12.8	11.7			36	12	16.5	
SS LUMPOC	AMERICAN	28	41.0 N	124.8 W	18	34	35	10 NM	02	1015.9	12.7	10.0	3	6.5	34	8	11.5	
SS HAWAIIAN PROGRESS	AMERICAN	28	30.8 N	126.0 W	12	34	35	10 NM	02	1015.0	12.2	13.4	6	11.5	34	9	14.5	
SS TOWER BRIDGE	SINGAPORE	29	43.0 N	166.3 E	06	26	M 40	5 NM	02	1003.5	9.5	9.0	7	13				
SS GULFPRINCE	AMERICAN	29	17.2 N	102.3 W	06	20	35 (A)	10 NM	13	1014.0	23.9	28.9						
MV CHASTINE MAERSK	DANISH	29	18.4 N	103.9 W	12	23	40 (A)	2 NM	65	1008.9	24.2	30.5	XX	10	19	9	16.5	
SS PENNMAN	AMERICAN	29	19.2 N	102.8 W	00	03	35 (A)	2 NM	13	1009.1	25.5	27.8	4	5	15	>13	19.5	
SS LUMPOC	AMERICAN	29	38.0 N	124.4 W	06	32	35	10 NM	02	1017.6	12.2	11.7	3	6.5	32	8	11.5	
SS HAWAIIAN QUEEN	AMERICAN	30	37.2 N	124.7 W	18	32	37	5 NM	03	1017.6	13.3	13.9	7	10	34	10	13	
SS SEALAND GALLOWAY	AMERICAN	30	41.0 N	178.5 W	00	27	40	5 NM	16	1005.8	12.2	10.0			25	< 6	8	
MV ASIA MARU	LIBERIAN	30	41.6 N	151.3 E	00	27	M 38	10 NM	00	1000.1	8.0	1.0			27	11	19.5	
MV HIEI MARU	JAPANESE	31	43.9 N	151.0 W	00	18	M 37	5 NM	64	1005.0	12.0	10.5	5	8	17	8	13	
SS PRES TAFT /NEW/	AMERICAN	31	48.9 N	157.5 W	06	04	40	2 NM	50	995.3	7.2	5.0	3	8	09	7	10	
MV THEMIS	NORWEGIAN	31	48.2 N	155.8 W	00	09	40	2 NM	80	996.0	7.0	8.0	10	10	09	12	10	
NORTH PACIFIC		JUNE																
MV MOSBAY	NORWEGIAN	1	40.7 N	153.0 E	12	09	M 38	1 NM	58	997.0	11.0	13.0			09	X	14.5	
SS PRES FILLMORE /NEW/	AMERICAN	2	40.8 N	159.8 E	00	07	35	10 NM	60	1000.3	10.3	10.0			07	< 6	10	
SS WILLIAM H ALLEN	LIBERIAN	2	36.9 N	175.5 E	18	27	36	2 NM	62	999.7	17.8	19.6	5	13	29	7	19.5	
MV JAPAN AMBASSADOR	JAPANESE	3	41.1 N	169.1 W	12	26	M 35	.5 NM	50	997.7	11.0	11.0						
SS SAN PEDRO	AMERICAN	3	37.9 N	173.3 W	06	26	38	2 NM	51	1000.0	15.8	13.6	6	8	26	9	16.5	
MV MANDARIN VENTURE	LIBERIAN	3	39.9 N	162.9 W	18	22	M 40	.5 NM	20	1006.3	13.8	12.0	7	19.5	25	9	23	
MV AMERICA MARU	JAPANESE	3	38.0 N	161.6 W	18	20	M 38	2 NM	62	1011.0	16.5	16.3	4	6.5	23	7	16.5	
SS TRANSINDIANA	AMERICAN	3	46.6 N	168.0 W	18	22	40	2 NM	01	982.0	8.3	7.2			24	10	19.5	
MV TOYOTA MARU #12	JAPANESE	3	44.2 N	165.3 W	18	25	M 41	2 NM	03	992.3	8.5	9.0	5	10	25	8	16.5	
SS INDIAN MAIL	AMERICAN	4	50.9 N	157.0 W	00	09	35	2 NM	81	991.2	5.0	5.5	6	10	09	7	14.5	
MV SKOGSTAD	NORWEGIAN	4	48.5 N	129.5 W	00	25	35	.5 NM	58	1003.7	9.0							
RV ALPHA HELIX	AMERICAN	4	51.9 N	168.1 W	06	05	M 40	2 NM	60	983.4	4.8	3.6	2	10	06	< 6	19.5	
MV TOYOTA MARU #12	JAPANESE	4	44.3 N	162.9 W	00	27	M 39	5 NM	02	998.8	11.0	10.0	6	13	23	8	21	
SS TRANSINDIANA	AMERICAN	4	46.4 N	161.2 W	06	23	50	1 NM	51	986.0	7.7	7.2	4	19.5	24	7	29.5	
MV VAN FORT	LIBERIAN	4	52.3 N	161.4 W	06	07	M 38	1 NM	93	982.0	7.0	5.0						
SS TRANSINDIANA	AMERICAN	5	40.1 N	155.3 W	00	25	40	5 NM	03	1000.4	10.0	8.3	4	19.5	24	7	29.5	
MV HAVIS	NORWEGIAN	5	49.5 N	138.3 W	18	25	35	5 NM	80	1012.0	13.0	9.0		11.5	26	X	16.5	
MV NORMANNIA	GERMAN	5	35.7 N	148.1 E	18	13	38	2 NM	80	1013.0	19.0	21.5	6	10				
SS PRES PIERCE	AMERICAN	5	35.8 N	148.3 E	18	11	M 35	5 NM	20	1014.6	19.4	19.4			13	10	11.5	
MV HAVIS	NORWEGIAN	6	50.9 N	139.8 W	00	25	40	5 NM	07	1007.0	11.0	9.0		16.5	26	X	37.5	
SS PRES PIERCE	AMERICAN	6	35.0 N	141.7 E	12	23	M 35	10 NM	01	1002.0	22.2	19.4	2	8	21	8	10	
SS MOBILE	AMERICAN	6	52.8 N	133.0 W	12	27	35	10 NM	00	1007.8	7.7	9.1						
SS JAPAN MAIL	AMERICAN	7	37.6 N	124.4 W	12	31	38	10 NM	02	1011.3	10.7	9.3	5	13				
SS HAWAIIAN QUEEN	AMERICAN	7	32.9 N	122.6 W	06	35	36	10 NM	03	1010.8	14.4	13.0			34	9	11.5	
MV LIECHTENSTEIN	LIBERIAN	7	38.0 N	152.6 E	18	29	M 36	1 NM	07	999.0	18.0	18.7	8	16.5				
SS HAWAIIAN QUEEN	AMERICAN	8	31.8 N	127.6 W	00	36	38	5 NM	09	1010.6	16.7	13.6			36	9	13	
SS JAPAN MAIL	AMERICAN	8	37.7 N	127.2 W	00	35	38	10 NM	02	1019.0	16.1	14.0	5	13				
MV PLUTOS	GERMAN	8	38.9 N	165.5 E	06	20	36	5 NM	20	1002.9	16.1	16.1			XX	X	6.5	
MV MANDARIN VENTURE	LIBERIAN	8	36.0 N	168.7 E	06	19	M 36	5 NM	03	1014.0	18.4	14.5	11	23	18	12	29.5	
MV LICA MAERSK	DANISH	9	13.3 N	128.3 E	18	20	40 (D)	10 NM	02	1001.0	28.0	28.0	6	10				
SS MARCONA PATHFINDER	LIBERIAN	10	19.0 N	120.5 E	18	08	35 (D)	5 NM	61	992.7	28.0	30.0	5	5	09	11	14.5	
SS PACIFIC BEAR	AMERICAN	10	52.9 N	178.9 E	06	13	M 35	2 NM	10	1020.0	5.6	5.6	3	6.5	13	7	11.5	
SS TRANSCHAMPLAIN	AMERICAN	13	39.6 N	145.2 W	12	36	35	5 NM	02	1015.2	11.7	10.7						
SS ATLANTIC PRESTIGE	AMERICAN	13	10.3 N	99.7 W	21	03	35 (D+)	5 NM	63	1004.7	24.0	28.9	2	5	14	8	13	
SS LESLIE LYKES	AMERICAN	13	14.3 N	96.7 W	06	09	35 (D+)	5 NM	64	1016.0	24.4	29.4	5	8	09	7	14.5	
SS GREEN LAKE	AMERICAN	15	15.6 N	101.0 W	18	04	50 (D+)	2 NM	64	1003.9	28.1	28.9	9	14.5				
MV GOLAR ARROW	LIBERIAN	15	15.3 N	97.8 W	18	12	M 43 (D+)	2 NM	10		26.0	30.0	9	13				
SS CALMAR	AMERICAN	15	15.5 N	97.2 W	00	10	43 (D+)	2 NM	64	1006.1	25.0	30.0	3	5	11	7	5	
SS JAPAN BEAR	AMERICAN	15	41.5 N	158.6 E	18	07	M 35	5 NM	03	1000.5	10.6	9.4			07	6	10	
SS SEALAND GALLOWAY	AMERICAN	16	40.5 N	162.8 E	18	29	40	5 NM	16	997.0	10.5	11.7	4	8	29	7	18	
SS OREGON MAIL	AMERICAN	16	41.3 N	161.4 E	00	07	35	2 NM	10	991.2	13.1	7.8	3	5	07	< 6	8	
SS PITTSBURGH	AMERICAN	16	38.3 N	162.2 E	12	27	40	5 NM	05	999.3	13.3	13.9	3	6.5	28	9	19.5	
SS GREEN LAKE	AMERICAN	16	13.4 N	99.6 W	06	29	35 (D+)	200 YD	64	1006.4	25.0	29.4	9	13				
SS GAGE LUND	LIBERIAN	16	16.2 N	98.9 W	12	09	35 (D+)	.5 NM	82	999.0	24.0	30.0	5	11.5	09	< 6	14.5	
SS JAPAN BEAR	AMERICAN	16	42.5 N	163.7 E	06	07	M 46	2 NM	03	998.0	8.3	7.2	6	10	09	10	13	

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb	Temperature °C		Sea Waves†		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC OCEAN		JUNE															
MV TAI MING	CHINESE	17	37.4 N	127.3 W	00	33	M 38	5	NM	05	1014.4	15.6	16.0				
SS SEALAND GALLOWAY	AMERICAN	17	40.7 N	168.4 E	00	26	40	5	NM	02	998.0	13.9	11.2	5	10	25	6	13
SS AMER LANCER	AMERICAN	17	39.2 N	128.4 W	00	34	35	10	NM	03	1017.9	16.2	13.4	4	11.5	35	7	16.5
SS PITTSBURGH	AMERICAN	17	39.2 N	167.5 E	06	27	35	10	NM	01	1004.4	15.0	17.2	3	6.5	26	10	16
SS JAPAN BEAR	AMERICAN	17	43.8 N	173.7 E	06	13	M 45	2	NM	51	1008.0	10.0	6.7	6	10	13	10	14.5
SS GUNVOR MAERSK	DANISH	17	40.8 N	164.5 E	00	27	33	5	NM	03	995.5	11.0	9.0			25	10	16.5
MV ISLAND PRINCESS	NORWEGIAN	17	44.7 N	124.8 W	06	35	M 42	5	NM	01	1011.4	14.0	12.0	5	6.5	35	9	11.5
MV CHEVRON MISSISSIPPI	AMERICAN	17	41.9 N	127.9 W	18	01	38	2	NM	02	1013.2	14.0	12.8	5	8			
SS WASHINGTON	AMERICAN	18	40.0 N	164.7 E	00	27	M 35	10	NM	02	1005.8	12.8	13.3	3	6.5	27	7	8
MV CHEVRON MISSISSIPPI	AMERICAN	18	42.7 N	128.9 W	00	35	35	5	NM	01	1015.5	16.2	12.3	4	8			
SS JAPAN MAIL	AMERICAN	21	21.3 N	123.1 E	06	33	35	10	NM	02	1004.7	29.4	27.2	4	8			
SS PRES GRANT (NEW)	AMERICAN	22	35.0 N	162.8 E	18	32	35	5	NM	50	998.3	14.9	16.2	3	5	35	8	13
SS AMER LEGION	AMERICAN	23	26.6 N	172.4 E	06	24	40	5	NM	60	1007.0	25.0	25.0			24	8	6.5
SS PRES GRANT (NEW)	AMERICAN	23	35.0 N	157.5 E	06	35	35	10	NM	07	1007.5	15.6	16.7	3	5	09	7	14.5
SS TRANSINDIANA	AMERICAN	24	36.3 N	144.6 E	06	20	35	2	NM	10	998.2	25.6	23.4	2	10			
MV ALASKA STANDARD	AMERICAN	25	37.2 N	156.0 W	00	23	40	2	NM	65	992.2	12.0	10.2					
SS HAWAII BEAR	AMERICAN	26	33.8 N	122.4 W	00	34	36	10	NM	02	1019.3	14.4	15.6	7	8	36	>13	18
SS WALTER RICE	AMERICAN	27	52.7 N	130.3 W	12	15	35	10	NM	50	1005.0	9.4	8.3	5	10			
SS WYOMING	AMERICAN	28	37.2 N	124.1 W	18	33	35	10	NM	05	1013.0	13.3	12.8	5	6.5	33	7	11.5

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind
(A) Tropical Storm Aletta
(D) Typhoon Dinah
(D+) Hurricane Dolores

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

(Continued from page 399.)

MARU. The raft had departed Chiba Prefecture, on April 27, and had drifted about 800 mi (1,480 km) to the east.

The Korean fishing boat HAE KUM KANG (726 tons) exploded and sank after a collision with the Japanese fishing boat No. 3 SHINKO MARU (423 tons) in thick fog, on the 29th, about 50 mi east of Cape Nosappu. Three crewmen died and 20 were missing from the Korean boat.

Rough Log, North Atlantic Weather

August and September 1974

ROUGH LOG, AUGUST 1974 -- The cyclone tracks look more like a winter than summer month, in number. As usual they were mostly north of 45°N latitude. The track from central Canada across Hudson Bay was well traveled but farther west, turning northward west of Baffin Island instead of into Baffin Bay. The two primary tracks across the northern ocean were normally located. The northern most track extended from Labrador east-northeastward to south of Iceland, the other, from south of Newfoundland extended northeastward to south of Iceland, where the two converge. A secondary track then continues into the Norwegian Sea. The climatic primary track from south of Iceland eastward into Scandanavia was represented by one storm. Storms along and off the U. S. east coast were below normal.

The Bermuda-Azores High was the dominant feature of the pressure pattern. The 1024-mb center was 2 mb higher than the climatic mean and located slightly farther to the east near 34° N, 38°W. The ridge that normally extends eastward across Europe was better developed and up to 4 mb higher in pressure. A 1008-mb Low was normally located over Hudson Strait. The usual High over the Greenland Ice Cap was 5 mb higher at 1018 mb. The major difference in the low pressure pattern was a 1005-mb Low centered south of Iceland near 60°N, 20°W. This reflected the convergence of the cyclone tracks in that area.

A large positive anomaly area extended from the eastern United States to eastern Europe. The Low south of Iceland resulted in a negative 5-mb anomaly centered south of its center. The higher pressure over northern Greenland produced a 6-mb positive anomaly over the Ice Cap, and also higher pressure over Baffin Bay.

The major difference from climatology in the upper-air pattern was a reflection of the surface Low south of Iceland. This produced a sharper trough west of 10°W. The heights of the pressure surfaces were higher than normal over Europe, across the central ocean centered on 30°N, and over the eastern United States. The trough that is normally located over the U. S. east coast was much farther west, over the Plains States.

Tropical storm Alma and hurricanes Becky and Carmen formed this month.

A front, out of a LOW located south of Cape Chidley, moved off the North American Coast on the 1st. It moved steadily eastward as the LOW hung back. On the 1200 chart of the 3d, a new 1000-mb LOW formed on the front near 50.5°N, 33°W. This resulted in a tighter gradient south of the new center. The HORNGOLF, near 42.5°N, 31°W, was east of the front with 35-kt southerly winds. West of the front the UKJG was near 44°N, 44°W, with 40-kt westerly winds. The LOW moved southeastward and then turned northerly by 1200 on the 4th. The HANNOVER sailing eastward passed through the front with heavy rain as the wind shifted to the south on the east side. The LOW continued its northerly movement until it dissipated near Iceland, on the 7th, as the front disintegrated against high pressure over Europe.

On the 7th, a front laid across the U. S. east coast, near Norfolk. At 1200, a wave formed over the Chesapeake Bay and moved off in a northeasterly direction. It traveled steadily at about 1010 mb resulting in only light rain and wind shifts for ships along its path. It was not until the 11th that it started to intensify and was 998 mb by 1200.

At 0000 on the 12th, the 990-mb LOW was at 56°N, 22°W and headed northward. The GENE TREFETHEN was at 57°N, 24.5°W headed eastward. At that time she encountered roaring (for August) 50-kt winds from the northeast in the northwest quadrant of the storm. She was also battered by 20-ft seas and 16-ft swells. Twelve hours later she was still experiencing 35-kt gales in the northeast quadrant as the storm drifted slowly northeastward. Several ships reported waves of 15 ft southeast of the center.

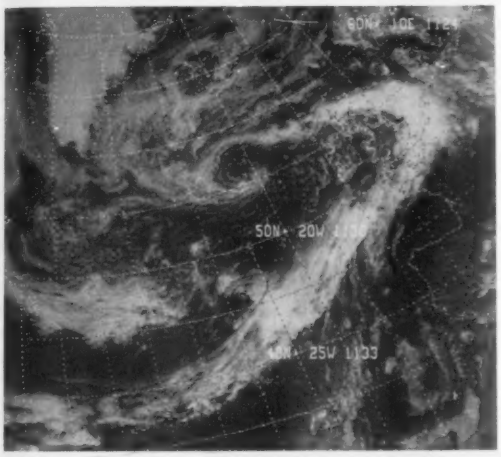


Figure 27. -- The frontal cloud band has moved far to the east of the quasi-stationary LOW.

The LOW stalled near 57°N, 21°W (fig. 27) and rapidly disintegrated as other LOWs approached from the southwest. This was the only LOW this month to form over the United States and move across most of the North Atlantic.

This small storm formed off the U.S. east coast, near 37.5°N, 71°W, at 1200 on the 10th. Its circulation expanded rapidly the first 12 hr. At 0000 on the 11th, Ocean Weather Station "H" was hit by 40-kt winds with 15-ft seas. To the south, 36.7°N, 73°W, the EXXON SAN FRANCISCO found 35-kt gales and 13-ft swells. The LOW used up some of its energy and appeared to weaken slightly, on the 12th, as it curved back northwestward and then turned northeastward again on the 14th. During this time it took a swipe at the UNION SUNRISE with 35-kt winds. The MORMACSCAN reported a thunderstorm.

The LOW now continued to move northeastward off the coast as a small storm. At 1200 on the 15th it was approaching St. Mary's Bay and VGBZ reported 35-kt gales. At 0000 on the 16th, SEDCO I was battered by 45-kt winds as the storm moved northwest of its position. Late on the 17th, the storm turned northward for 24 hr before continuing northeastward. No other gale reports were received, until 1200 on the 19th, when the SEATRAIN LOUISIANA found the 35-kt isotack near 52°N, 31°W at 1200 on the 19th. Along with this she had heavy drizzle, 10-ft seas, and 16-ft swells.

On the 20th, the LOW was south of Iceland and, by 1200 on the 21st, was to the east. A ship for which the call letters were not plotted radioed a report of 40-kt gales at 58°N, 23°W. This was to be the last report connected with this long-lived storm as it was absorbed by a Greenland Sea LOW on the 22d.

On the 21st, a col was located over the Labrador Sea south of Greenland. On the 22d, a LOW formed in that area and started moving eastward and expanding. At 1200 on the 23d, the LOW was near 58°N, 31°W, at 994 mb. Kap Farvel reported 35-kt summer winds of 37°F. The HILAIRE MAUREL, off Hamilton Inlet, reported 40-kt gales with 13-ft seas and swells.

By 1200 on the 24th, the 980-mb cyclone was south of Iceland near 58°N, 27°W. The front had moved to the outer fringe of the circulation, and the stronger winds were reported near the front. Two 40-kt reports were plotted at that time; by the PORT MARLY ahead of the front near 49.3°N, 21.5°W, and the SEALAND VENTURE behind the front near 47°N, 32°W. As the storm center brushed the east coast of Iceland on the 25th, it reached its lowest pressure of 974 mb. On the 26th, there were two reports of 40-kt gales, one by Ocean Station Vessel "T" and the other by a ship that was probably plotted at the wrong location. The storm moved northward into the Greenland Sea and treated the weather station at Dove Bay to 45-kt freezing winds. The storm could not withstand the cold climate as it expired on the 29th.

This storm developed off Cape Race, on the 25th, as a 1011-mb frontal wave. On the 26th, it absorbed a LOW that had moved out of Quebec and the system intensified. The VGBZ reported 50-kt winds in Cabot Strait. The LOW moved northeasterly and was 990 mb, on the 27th, near 56.5°N, 28°W. At 1200, the JOHN CABOT contended with 40-kt gales blowing 18-ft seas at 49°N, 23°W. Two other ships had 35-kt gales in the same general area. At 0000 on the 28th, the QUEEN ELIZABETH 2 was racing along with 40-kt winds on her stern. As the storm center moved over the George Bligh Banks, Ocean Station Vessel "J" measured 35-kt winds. On the 29th, the LOW suddenly started filling and by the 30th was gone.

Tropical Cyclones, Atlantic--Alma began as a small cloud mass that moved across the eastern Atlantic at about 10°N. On the 11th and 12th the system increased in size and showed some circular organization. A Navy reconnaissance plane found a tropical storm circulation with maximum winds of 50 kt on the 13th. Alma was unusually far south and moving westward at an unusually fast speed of 20 kt for such a low latitude. The storm was just 450 mi east of the Windward Islands on the 13th. Her center reached Trinidad on the morning of the 14th. Winds of 30 kt with gusts to 47 kt were reported on the Island. A few hours later Alma was onto the north coast of Venezuela. Only three other recorded storms have moved across the Paria Peninsula of Venezuela: one in 1605, one in 1725, and

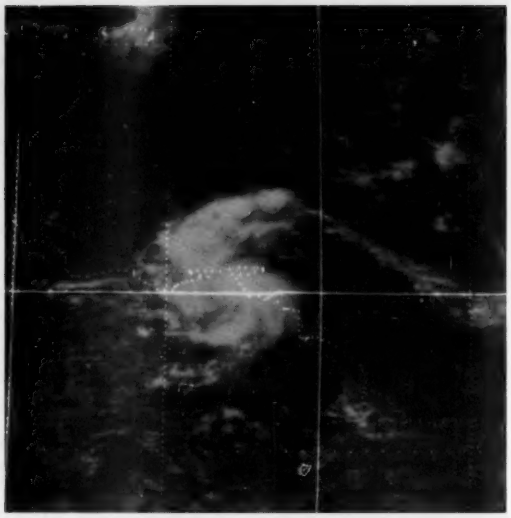


Figure 28. -- Tropical storm Alma, the 4th storm on record to cross the Paria Peninsula of Venezuela.

one in 1933. The storm remained partially over water (fig. 28). Strong winds continued in the rain bands of the northern semicircle. On the 15th after passing Caracas Alma moved inland and began to weaken. After moving past Lake Maracaibo into the high terrain she dissipated late on the 15th.

Reports from radio and the press indicate some trees were felled and houses unroofed on Trinidad. In Venezuela there were landslides. Also a Venezuelan aircraft crashed on Margarita Island due to bad weather in advance of the storm; 46 people were killed.

An area of cloudiness and shower activity was first visible by satellite well to the northeast of the Leeward Islands on the 20th. This system moved slowly westward for 4 days. On the 24th it was located several hundred miles north of Puerto Rico. A gradual organization of the cloud pattern became evident on this date with a circulation center finally visible on the 25th. As pressures began to fall over the western Atlantic, ship reports and satellite pictures confirmed the development of the 5th tropical depression of the season on the 27th. Aircraft flights that afternoon indicated the depression had a minimum pressure of 1010 mb with winds up to 40 kt in squalls. A flight the next morning reported the pressure had dropped to 1000 mb and squalls to 70 kt were observed. Becky was a hurricane by 0000 on the 29th, and was moving north-northeastward at 10 kt. From the 29th through the 31st, Becky moved slowly northeastward and continued to strengthen. Winds were estimated in excess of 100 kt on the 30th, with the lowest pressure 977 mb. No further flights were made into Becky since the storm could be followed very easily by satellite. Pictures indicated that the storm continued to strengthen until the 31st when Becky turned on a more easterly course with a gradual increase in forward speed (fig. 29). On September 2 the hurricane merged with a frontal zone northwest of the Azores and lost all tropical characteristics. Becky was never a threat to land but did pass through the main shipping lanes and created a considerable delay in Atlantic crossings for a few days.

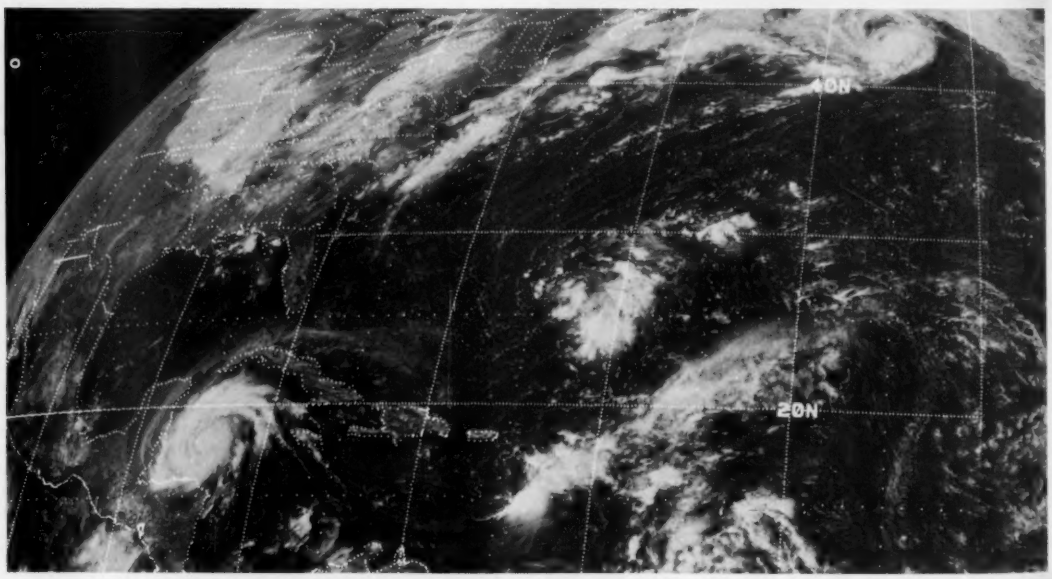


Figure 29. -- Hurricane Carmen heads for the Yucatan while Becky is about to merge with a frontal system in the North Atlantic at 1600 on the 1st.

Carmen attained the lowest central pressure (928 mb) of any hurricane since Camille of 1969. It easily could have been one of the most devastating storms of recent years, but fortunately on the two occasions just prior to landfall it veered away from heavily populated areas, thus sparing Belize City and New Orleans.

The forerunner of Carmen was first detected as an easterly wave which passed Dakar and the Cape Verde Islands during August 23-24. The wave crossed the tropical Atlantic, moving westward about 17 kt in the trade winds during the next 4 days. A reconnaissance flight investigating the disturbance east of the Leeward Islands on the 28th found little evidence of a closed wind circulation. However, the following day a Navy flight found that a depression had formed about 180 mi east of Guadeloupe. It crossed into the Caribbean Sea, near Guadeloupe, during the late afternoon and gradually intensified. It probably acquired tropical storm strength while passing south of the Mona Passage during the morning of the 30th; the system was named Carmen.

Heavy rains and gusty winds occurred over the Leeward Islands north of Guadeloupe as the depression passed but no damage or injuries were reported. In Puerto Rico most of the rain fell between noon on the 29th and noon on the 30th. Reports from Puerto Rico place the damage estimate in excess of $2 million. One man was electrocuted while clearing fallen branches. A tornado occurred on the 30th; it destroyed two homes and damaged several others. Flash floods caused 55 families to evacuate in Carolina.

Carmen followed a due westward course through the eastern and central Caribbean Sea, skirting the south coasts of Hispaniola and Jamaica. She became a minimal hurricane during the morning of the 31st as she came under surveillance of the Kingston, Jamaica, radar. Montego Bay experienced sustained gale-force winds for about 4 hr, and heavy rains fell over the island. The center passed a short distance north of Swan Island during the morning of September 1. The island experienced sustained gales for about 4 hr. The highest sustained winds were 50 kt with gusts to 65 kt, and the lowest pressure was 993.8 mb. The 24-hr rainfall , on the 1st, was 2. 87 in.

Carmen maintained its westward course, heading toward the area which had been devastated by two of the most severe hurricanes on record (fig. 29). Hurricane Janet destroyed Chetumal, Mexico and severely damaged Corazel, British Honduras, in 1955, and hurricane Hattie struck British Honduras in 1961. The lowest pressures in these two hurricanes were, respectively, 914 mb at Chetumal in Janet, and 920 mb before landfall in Hattie. It was feared that Carmen might prove as devastating as Hattie and Janet. However, as the eye became visible on the Belize radar, it was seen to shift gradually to the northwest. This trend continued until the eye reached the coast and resumed a westward track inland over Yucatan. This temporary deviation which lasted about 7 hr, was sufficient to carry the center and the strong north semicircle of the hurricane away from the populated areas of Belize City and Corozal in Belize. According to reports received through the Belize Meteorological Service, hurricane-force winds began at Chetumal at 1030 on the 2d, and continued until 1600. The peak wind occurred at 1330 and was measured at 118 kt, sustained. The lowest recorded pressure at Chetumal was 956 mb.

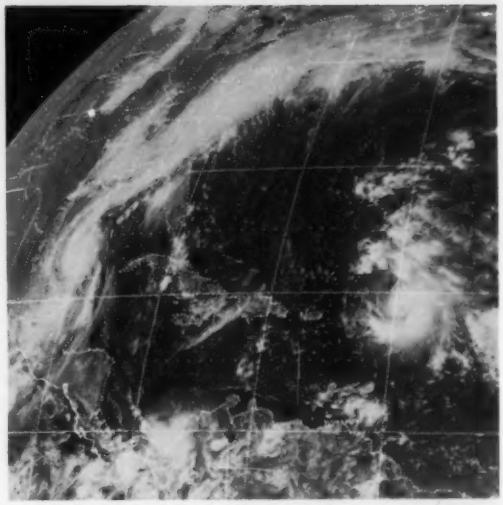


Figure 30. --Carmen is reintensifying in the Gulf of Mexico, at 1600 on the 6th, while Elaine is just getting it together for the first time, east of Puerto Rico.

Carmen weakened as she meandered northwestward across the Yucatan Peninsula for the next 30 hr. She emerged as a tropical storm into the Bay of Campeche during the afternoon of the 3d with the central pressure about 1000 mb. During the next 48 hr Carmen dallied off the west coast of Yucatan, covering a distance of only about 100 mi. As more of the circulation moved over the water the storm gradually strengthened and reached hurricane force during the morning of the 5th. Carmen continued northward and intensified (fig. 30). She reached her maximum intensity in the Gulf as she approached the Louisiana coast on the 7th. Reconnaissance data indicated a central pressure of 937 mb, and surface winds were estimated at 140 kt. The hurricane was moving slightly west of north and turned toward the northwest during the evening.

Cool air began entering the storm's circulation while the center was still offshore, and some weakening occurred before landfall (fig. 31). The center crossed the neck of land in Terrebonne Parish just east of Point Au Fer, and moved across eastern Atchafayala Bay and inland near Belle Island, 15 mi southwest of Morgan City. The hurricane weakened rapidly as it moved inland, and radar indicated that it was unusually dry. The highest sustained wind measured on land was 74 kt at Morgan City. The same observer also recorded the lowest land station pressure reading available - 982 mb. However, the center passed about 15 mi southwest of Morgan City so the central pressure was somewhat lower. Carmen was downgraded to a tropical storm on the 8th. Winds dropped below gale force while the center was over southwestern Louisiana during the afternoon, and the remnants were tracked into eastern Texas where the circulation gradually lost identity near Waco late the following day.

Figure 31. -- The sign says it all as Carmen's winds whip up waters of Lake Pontchartrain at New Orleans on the 7th. Wide World Photos.

Only one death (by electrocution from fallen wire) was directly attributable to Carmen. More than 75,000 people moved inland ahead of the storm. Property damages along the track were not excessive due to the rapid weakening. Losses to the sugar cane industry were estimated at $90 million. The offshore oil industry losses were not great.

Casualties--Weather casualties were light as would be expected in a summer month. The 16,988-ton Liberian registered LIPS collided with the 15,053-ton Korean HANYANG in the Mississippi River Anchorage, on the 17th, when she lost her anchors in high winds.

ROUGH LOG, SEPTEMBER 1974--In general, September was a near-normal month, across the North Atlantic. As usual there were exceptions. One of the more important of these was in the northeast area -- Norwegian and North Seas and United Kingdom. Except off the U. S. east coast the extratropical storm centers stayed north of 40°N.

From the northwest to the southeast the primary climatological storm tracks are as follows: Hudson Bay to the southwest coast of Greenland, southern Canada to Labrador to Iceland into the Norwegian Sea, off the U. S. east coast to south of Iceland, and the North Sea across the Gulf of Finland.

The following are the exceptions in the actual mean tracks. The Hudson Bay-Greenland track was farther south in c ıtral Canada and curved northward sooner over Baffin Island. The track from Labrador to the Norwegian Sea was more easterly with a sharp northward curve near the southern Norwegian Coast. The U. S. east coast storms also had a more easterly component and moved over the United Kingdom turning northward over the North Sea. Only one storm ventured into the Baltic Sea area.

The pressure pattern was near normal, but more intense. The Bermuda-Azores High was the largest feature and about 5 mb above the climatic mean with two 1025-mb centers near 35°N, 42°W, and 37°N, 30°W. Another high-pressure feature was a 1017-mb High centered over northern central Greenland. The Icelandic Low, normally between Kap Farval and Iceland, was split into two centers both lower than the climatic mean. The deepest Low was north of the Shetland Islands, near 65°N, 01°W, at 999 mb. The other Low was 1005 mb over the Fury and Hecla Strait of Northern Canada. The pressure over the eastern United States and Canada was normal.

There were two positive and two negative anomalies that were significant. A positive 6-mb was centered over the north central Greenland Ice Cap. A large positive 5-mb center was near 35°N, 30°W, with the 4-mb isoline roughly covering the area from 30° to 40°N and 10° to 50°W.

The two negative anomalies were located near the Low centers. The largest, a negative 10-mb, was centered near 61°N, 01°W, with negative values covering all the area northeast of a line from Kap Farvel to the Bay of Biscay to central Italy to the White Sea. The

other negative center was minus 4 mb centered with the Low over northern Canada.

The upper-air pattern also had a more intense gradient. The center of the High over the Middle Atlantic was 195 ft higher than the mean for the 700-mb surface. The two upper-air Lows were reversed from the surface Lows in intensity. According to climatology the primary mean Low is centered over the North Pole. This month it was over 1,200 mi away. near 69°N, 88°W (not far from the magnetic North Pole), and associated with the surface Low near that point. This produced a negative anomaly of over 340 ft for the height of the 700-mb surface near that position. The upper-air Low associated with the surface Low over the Norwegian Sea resulted in a 300-ft anomaly.

The North Atlantic hosted four tropical cyclones this month, two tropical storms - Dolly and Elaine - and two hurricanes - Fifi and Gertrude. Although it formed the last of August, hurricane Carmen spent most of her life-span during September.

A front extended east-west across the Atlantic to Nova Scotia where it curved southwestward along the coast, on the 4th. A large HIGH was centered over the midwest, and tropical storm Dolly was moving northeastward off the U. S. east coast. Late in the day a wave formed off the southwest corner of Newfoundland.

The LOW raced across the Atlantic, traveling 1,000 mi in 24 hr. At 0000 on the 7th, it was at 53°N, 12°W with a pressure of 969 mb. The ship GUJL was off Lands End and being battered by 50-kt winds from the southwest. The SASHA BORODULIN was, near 49°N, 10°W, not far away and taking a 40-kt beating. During this melee a merchant ship sank in the English Channel and the crew was rescued by helicopter (fig. 32).

The storm maintained its strength as it passed over central England, but the winds were not as strong. The DART AMERICA was on the receiving end of 35-kt gales at 48.5°N, 11.5°W, at 1200, with no other reports between her and land.

The LOW had slowed as it turned northeastward and was weakening as it moved up to the coast of Norway on the 8th. A station on the Netherlands coast reported 40-kt gales at 1200. The storm continued

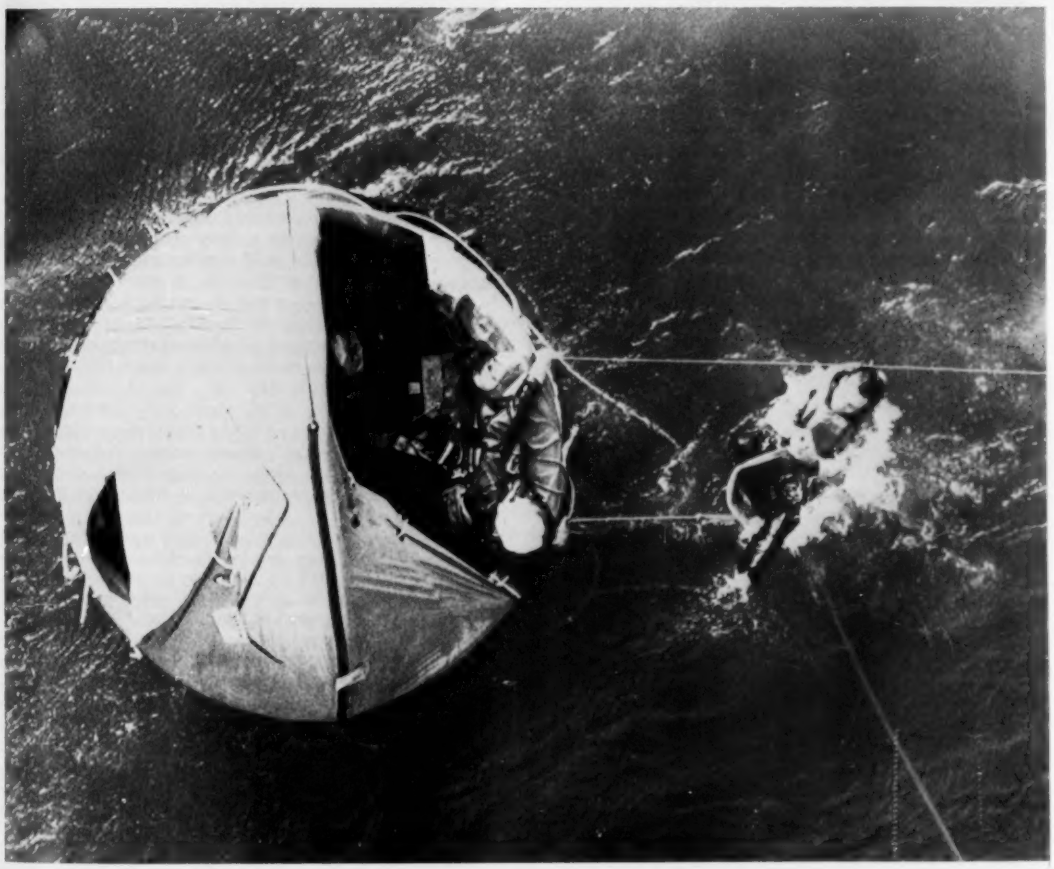


Figure 32. -- A crewman from the merchant ship that sank in the English Channel takes a bath before being pulled aboard the rescue helicopter. He is being assisted by someone still in the raft. Wide World Photos.

tracking northward until it was over Spitsbergen.

At midday on the 7th, a wave formed on a front east of Long Island. It moved northeastward, as is the usual case, and, by 1200 on the 8th, was a 993-mb storm over the Grand Banks. The DAWSON was tossed by 50-kt winds west of Cape Breton Island. The WIELDRECHT just to the north off Sydney had 45-kt northeasterly gales.

The storm turned to an easterly track and, at 0000 on the 9th, the ATLANTICA LIVORNO was hit by 40-kt gales at 41.5°N, 46°W. In the next 12 hr the central pressure dropped 13 mb to 972 mb. The EXPORT LEADER, near 40°N, 41°W, was caught by 45-kt gales with 16-ft seas and 20-ft swells. About 400 mi south of the center (44°N, 37°W) the USNS COMET was headed into 40-kt gales. Gale-force winds were reported in all quadrants. On the 10th, four ships reported 45-kt gales. They were the HORNWIND, KARA, PAULA, and PUEBLA. Three of these reports were in the southwest quadrant. Gale reports were in all quadrants except to the north where none were plotted. The KARA reported swells of 33 ft.

On the 11th and 12th, the LOW was headed towards Ireland and filling rapidly. The LOW split into two centers and, on the 13th, the circulation combined with another LOW over Iceland.

A 1009-mb wave was analyzed over Michigan on the 0000 chart of the 13th. Twenty-four hours later, it was over New Brunswick at 999 mb. The VGBZ off Cape Sable recorded 40-kt gales. As the storm moved over the water it steadily gained strength. At 1200 on the 16th (fig. 33), the 975-mb center was 150 mi south of Keflavik. The BAMSA DAN, near 61°N, 20°W, was tossed by 50-kt winds and 33-ft seas. The OXKJ, at 59.1°N, 22.7°W, struggled with 45-kt winds and 30-ft seas. Ocean Station Vessel "I" slightly farther south was in better shape with only 40-kt gales, 15-ft seas, and 13-ft swells. On the 17th, the LOW moved into the Norwegian Sea and joined another LOW farther north.

Figure 33.--The tightly coiled storm is poised to batter the BAMSA DAN with high winds and seas.

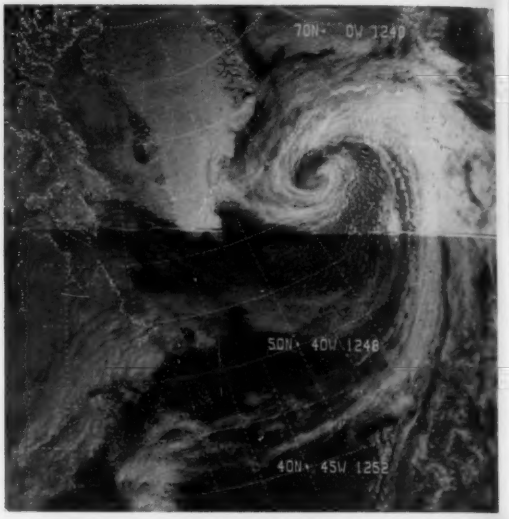


Figure 34.--Another storm in that dangerous area of the North Atlantic, between Greenland and Iceland.

Cape Hatteras produced this storm. It started innocently, on the 17th, as a very minor frontal wave. Its path was along the Gulf Stream as it raced northeastward. At 0000 on the 19th, it was already over St. Mary's Bay. A ship had 40-kt southwesterly winds near the warm front at 46°N, 49°W.

The storm continued its northeasterly course and had a central pressure of 972 mb about 100 mi south of Keflavik on the 20th (fig. 34). The MARIE L. BOLTEN was near 58°N, 30°W, about 350 mi southwest of the center, headed into 50-kt westerly winds, 26-ft seas, and 31-ft swells. Ocean Station Vessel "I" had been receiving 40-kt winds for over 6 hr. At 0000 on the 21st, her winds increased to 45 kt and the seas were 23 ft.

At this time the center was just south of the coast of Iceland and taking on a southerly component in the track. The ORDUNA reported 50-kt west-northwesterly winds, at 1200 on the 21st, with 30-ft swells, near 53.5°N, 18.6°W. Farther to the southwest the C. P. DISCOVERER, near 52°N, 25°W, was headed into 45-kt gales and 26-ft seas and swells. There were many gale reports in the southern half of the storm's circulation. By 0000 on the 22d the winds had decreased to 35 kt from the northwest at OSV "I" but the seas were 26 ft and the swells 23 ft from the west-southwest. The storm center was recurving to a northerly direction. Even so, its effect was felt as far south as Cabo Finisterre where the GMPJ had 40-kt gales.

As the LOW moved into the Norwegian Sea it lost its punch, but managed to survive as a system, until the 29th, over Spitsbergen.

Tropical Cyclones, Atlantic--The beginnings of tropical storm Dolly were first noticed on satellite pictures on August 30 when a cluster of convective clouds formed under an upper-level cold LOW about 700 mi east-southeast of Bermuda. This tropical weather system drifted across the North Atlantic for a few days until, at 1800 on September 2, ship reports indicated that a tropical depression had formed about 350 mi south-southwest of Bermuda. This depression moved toward the northwest at 10 kt for 24 hr. On the 3d, a reconnaissance aircraft found a central pressure of 1005.7 mb and surface winds of 45 kt about 400 mi west-southwest of Bermuda. These values turned out to be the minimum measured surface pressure and maximum surface wind attained by Dolly during the tropical portion of her history. At this time the system was upgraded to tropical storm Dolly. She quickly began recurving into the westerlies, first moving northward for 24 hr, then northeastward merging with a cold frontal cloud band early on September 5 and becoming extratropical.

After becoming extratropical and accelerating to a forward speed of 30 kt, the remnants of Dolly, in combination with the cold front, passed very near Sable Island where northerly winds of 33 kt with 54-kt gusts, and 1004.8-mb pressure, were recorded.

The disturbance which was to become tropical storm Elaine came off the African coast on the 2d, and moved across the eastern part of the tropical Atlantic at 20 kt for the next 2 days. It was classified as a tropical depression on the 4th, about 1,200 mi east of the Leeward Islands, after a Navy reconnaissance flight had found a disorganized center with a sea-level pressure of 1012 mb. The system remained poorly defined for the next 2 days. On the 6th, satellite pictures indicated that the system was rapidly becoming better organized (fig. 30). However, no definite center could be located by reconnaissance until the 8th when Air Force and Navy reconnaissance flights found a closed circulation with some flight level and surface winds in excess of tropical storm strength, even though the lowest pressure was 1008 mb. The storm was named, on the 9th, as it began to recurve northeastward, some 225 mi east-southeast of Cape Hatteras.

Thereafter Elaine continued generally northeastward. The lowest pressure measured throughout its history was 1001 mb on the 10th. As the storm neared a cold front 600 mi off Cape Race, Newfoundland, on the 13th, it rapidly lost tropical structure.

Fifi was the severest hurricane of record to affect Honduras. This was true not because the minimum central pressure of 971 mb or maximum sustained winds of 95 kt were any more extreme than several earlier hurricanes. But, as in Agnes of 1972 in the Unites States, almost all of the deaths and damages resulted from river floods caused by torrential rains increased by mountainous terrain.

The disturbance which eventually developed into Fifi left the African coast as an impressive looking convective system, on satellite pictures, late on the 8th. The system first showed signs of development on the 13th, and the following day a Navy reconnaissance aircraft found some evidence of a closed circulation. Reconnaissance aircraft located a well-developed depression with sustained winds of 30 kt about 60 mi south of Haiti late on the 15th. Fifi became a tropical storm on the 16th when sustained winds of 40 kt were reported just south of Jamaica. She reached hurricane strength the next morning while located about 250 mi east of Swan Island (fig. 35). By midday of the 18th, the hurricane had achieved maximum strength; a Navy reconnaissance aircraft measured 700-mb flight level winds of 95 kt. Little change in strength was noted during the next 24 hr; an Air Force reconnaissance flight measured the lowest central pressure of 971 mb before daybreak of the 19th. Some weakening of the hurricane took place as it approached southern Belize with the central pressure rising to 982 mb just prior to landfall at La Placencia around 2100.

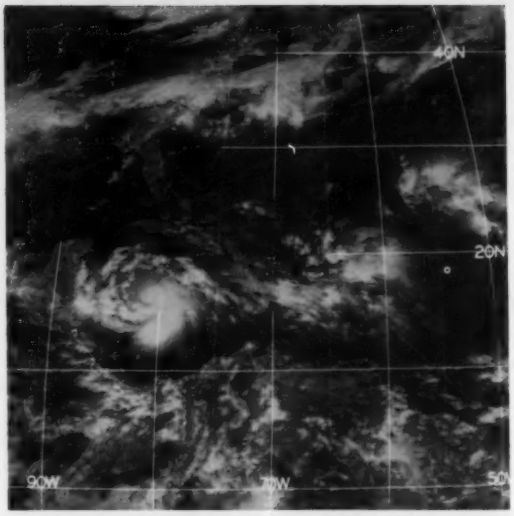


Figure 35.--Fifi shows off her hurricane circulation, on the 17th, as she nears Honduras.

Fifi weakened rapidly to tropical storm strength after moving into the Maya Mountains of Belize during the evening of the 19th, and was downgraded to a depression after moving into southern Mexico on the morning of the 20th. The depression regained strength as it approached the eastern North Pacific near Acapulco and was designated tropical storm Orlene. Further strengthening to a hurricane with 75-kt winds took place before final landfall about 40 mi south of Culican, Mexico. Acapulco reported over 11 in of rain in a 6-hr period on the 22d.

The primary effect of the storm in Jamaica was over 8 in of rain in 2 days in the southern portion. Swan Island reported easterly winds of 65 kt with gusts in excess of 85 kt and a minimum sea-level pressure of 996 mb on the 18th.

Fifi headed toward Honduras, which received the brunt of her devastating forces. The eyewall of Fifi raked the offshore Bay Islands and the north coast as the eye of the hurricane passed between them. Peak winds were estimated at 115 kt on the Island of Guanaja, while La Ceiba reported 85 kt. Puerto Barrios, Guatemala, reported sustained winds of 65 kt from the west. Tides of 8 to 12 ft above normal were reported

Figure 36.--The flood waters from Fifi, on the 22d, inundate banana plantations and flood the homes of workers in northern Honduras. Wide World Photos.

along the north coast from Puerto Castilla westward to La Ceiba and Tela. The greatest devastation was produced by the torrential rains associated with the hurricane (fig. 36). The only reported figure was up to 24 in within 3 days in the mountains along the north coast. The subsequent river flooding produced most of the deaths and damages attributed to Fifi. In addition, the development of a temporal or broad southwesterly flow of moist air from the Pacific Ocean induced by the hurricane also caused heavy rains and resultant crop damages in southern Honduras, Guatemala, and El Salvador. The southern portion of the Country of Belize received some damage as the center of Fifi passed inland over La Placencia. Peak winds there were estimated at 85 to 100 kt, tides at 10 to 12 ft above normal, and storm rainfall at 6 in. Stann Creek measured 70-kt gusts, and Belize City 40 kt. Tides were 2 to 4 ft above normal as far northward as Belize City.

All of the casualties reported thus far have been in Honduras with conflicting estimates of the total death toll. The following is taken from a newspaper article out of San Pedro Sula, Honduras (Miami Herald, September 27, 1974):

> "Major Thomas Morgan, Chief of the U. S. Army disaster area survey team, said that based on confirmed bodies and reliable sources he would say the total number dead is 1,000. His estimate differed sharply from the official estimate of the Honduran Government that the flooding of the hurricane killed 7,500 to 8,000 people. Major Morgan also said that the total homeless probably was 100,000. The Honduran Government's estimate of homeless is 300,000 to 350,000."

Crop losses were in the millions of dollars, and the percentage of the crop loss was exceedingly high in Honduras.

A tropical disturbance originated in the Intertropical Convergence Zone just off the northwest African coast on the 22d. It moved west-northwestward at about 15 kt and began to show signs of organization, on satellite pictures, by the 26th. On the 28th it was apparent that a tropical depression had developed. Reconnaissance aircraft found that the system had strengthened rapidly and reached hurricane intensity during the afternoon of the 28th. Gertrude never developed the characteristics of a well-organized hurricane. The lowest pressure measured by aircraft was 999 mb, on the 28th, and a well-defined wall cloud was never observed. The 80- to 100-kt winds reported by both the Air Force and Navy aircraft have been related to short period accelerations as the storm attempted, but failed, to develop a wall cloud.

An upper-level trough which had developed over the eastern Caribbean and Lesser Antilles several days prior to the arrival of Gertrude began to affect her circulation on the 30th. She began to lose strength as she became stationary some 250 mi east-southeast of Barbados. Aircraft reported winds were only on the order of 45 kt during the afternoon of the 30th. Gertrude continued to weaken on October 1 and was downgraded to a tropical depression on the 2d just prior to reaching the Windward Islands. The weakening depression moved into the southeastern Caribbean on the 3d and gradually dissipated.

Casualties--The only other weather casualty noted this month was the 1,057-ton ORMLUND. While anchored outside Belize for repairs, high winds caused the vessel to drag anchor and run aground on the lighthouse reef.

Rough Log, North Pacific Weather

August and September 1974

ROUGH LOG, AUGUST 1974--The North Pacific was quiet this month, even for a summer month, as far as extratropical cyclones were concerned. The same can not be said for tropical cyclones. The extratropical storms in general were weak. There were several deep storms, but they did not generate exceptionally high winds, at least they were not observed and reported.

The storm tracks were more dispersed than usual, located more easterly with more of a northerly component. According to climatology there are three primary tracks; one from Mys Loptaka across the Bering Sea to the Bering Strait, another from Honshu to the Priblof Islands, and the other from about 50°N, 160°W into the Gulf of Alaska. In general the Mys Loptaka track storms curved more northerly and into eastern Siberia. The Honshu track originated further east and also curved more northward into the western half of the Bering Sea. The track south of the Alaska Peninsula was located about 10° latitude farther south (40°N) and traced a path eastward.

The mean pressure pattern did not match climatology very well, as might be expected since the cyclone tracks did not match well. The dominant feature remained the Pacific High, but its orientation was quite different. The main center was 1024 mb located near 50°N, 140°W, with a subcenter of 1018 mb near 30°N, 180°. It had a boomerang shape. The climatic mean is an egg shape lying on its side with the small end pointed westward and a 1025-mb center near 40°N, 150°W.

The normal location of the mean 1009.8-mb Aleutian Low is near Mys Navarin. This month there were two centers, a 1005-mb near 52°N, 173°E and a 1007-mb in the Sea of Okhotsk near 53°N, 147°E. The pressure over the western third of the ocean was well below normal with two Low centers, one near Daito Jima and the other midway between Hainan and northern Luzon. The pressure over Alaska was above normal.

The anomaly pattern was interesting with all the misplaced centers. A large area of the central ocean was covered by negative anomaly isolines. A negative 8-mb center was located near 40°N, 160°W. Another negative 8-mb center was located near 28°N, 138°E. The pressure all along the North American Coast was above normal with a positive 6-mb center located north of Anchorage.

The upper-air pattern more closely resembled climatology with an elongated High centered along 30°N. A LOW was centered over the Bering Sea where normally only a trough exists. The high pressure off the West Coast was reflected by a well-defined ridge in the upper air. As with the surface the heights of the pressure surfaces were low over the Philippine and South China Seas. The anomaly pattern matched the surface with positive values over Alaska, and negative centers in midocean and over southwestern waters.

There were six tropical cyclones in the western North Pacific; two typhoons, Mary and Polly, and four tropical storms, Lucy, Nadine, Olive, and Rose. In the eastern North Pacific there were seven tropical cyclones; five hurricanes, Ione, Joyce, Kirsten, Maggie, and Norma, and two tropical storms, Helga and Lorraine.

This first storm was minor and just did make it over water before dissipating. It came out of Manchuria fairly well developed for this time of year. By the 3d, its circulation was affecting the Sea of Okhotsk. At 1200 on the 4th, the front was paralleling the Kuril Islands and the ARKHIP KUINDZHI was blown by 40-kt winds east of the occlusion near 50°N, 153°E. Late on the 5th, the circulation was dead.

On the 11th, a high-pressure center was located near Ocean Station Vessel "P" with low pressure over the Great Basin of the United States. The SEALAND EXCHANGE found 40-kt winds in an area of tight gradient off Cape Mendocino.

The Pacific north of 35°N contained a series of relatively small LOWs on the 18th. On the 19th, a new LOW developed, near 41°N, 171°W, at the triple point of the front extending from the one nearest midocean. The BIRTE HUGO STINNES was near 34.5°N, 172°W, just east of the cold front, with 45-kt gales and 21-ft seas and swells. It moved eastward (fig. 37) and, on

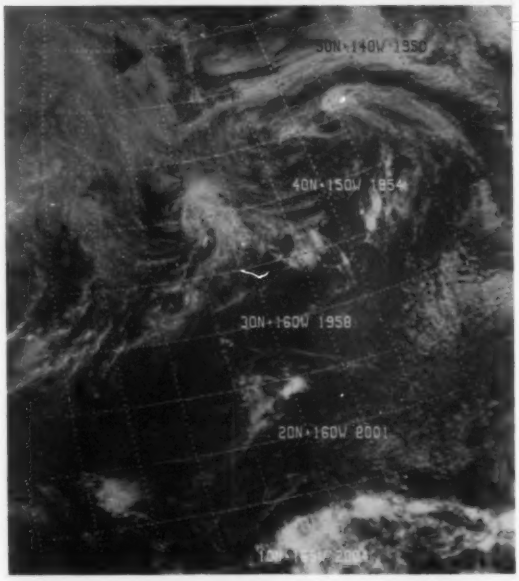


Figure 37.--The LOW is near 40°N, 163°W at 1955 on the 19th. The cloud cover does not indicate a strong storm.

the 20th, there were no ship reports in the area of the storm where the previous strong winds had been observed. On the 21st, the MANCHESTER CONCEPT reported 35-kt winds about midway between two of the LOWs. At 1200 on the 21st, the LOW was at 43°N, 152°W and the KNFD was at 36°N, 155.5°W with 40-kt gales.

The LOW turned northeastward on the 22d and then eastward again on the 23d while increasing in pressure. On the 24th it turned southward and dissipated.

On the 22d, a front stretched east-west across the Sea of Japan from northern Honshu to North Korea. Tropical storm Mary was emerging from the Chinese mainland to regenerate over the East China Sea. This circulation pulled that portion of the front over the Yellow Sea southward, and on the 23d and 24th waves were forming along the front and moving northeastward over the Sea of Japan. As one of these passed along the Kuril Islands, Ostrov Simushir measured 50-kt winds, on the 24th. The BENVORLICH (36°N, 149°E) and the GOLAR BOW (42°N, 150.5°E) reported 35- and 40-kt winds respectively, on the 25th.

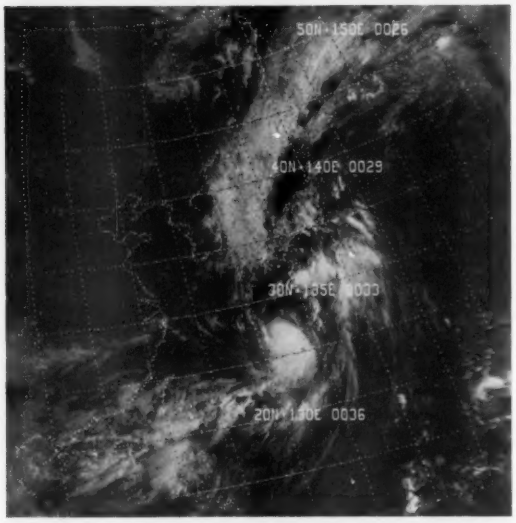


Figure 38.--The wave that developed later in the day, near 40°N, 140°E, is not readily apparent in this earlier satellite picture. Typhoon Mary is near 25°N, 133°E.

At 1200 of the 25th (fig. 38), one of these waves developed sufficiently to persist and identify from one chart to another. This LOW moved rapidly north-northeastward at about 55 kt. At 0000 on the 26th it was at 49°N, 147°E, and 992 mb. The Kuril Island of Simushir again was hit by 50-kt winds. By the 27th, the LOW was moving eastward over the top of a HIGH and the DAIAN MARU, near 46.5°N, 167°E, was sailing into 35-kt gales.

Now that the storm had moved over warmer waters and over the top of the ridge it started to intensify. At 0000 on the 28th, it was near 50°N, 175°E. Earlier the LOW center had passed near the MARUSUMI MARU and now treated her to 55-kt winds, 31-ft seas, and 20-ft swells. Her location was 49°N, 174°E, or about 120 mi west of the center. The LOW now had a southerly component to her track before turning northward toward the Bering Sea on the 29th. At 1200 on the 28th, the PHILIPPINE MAIL was lashed by 45-kt gales near 47°N, 179°W. This was near the same relative position to the storm's center where the MARUSUMI had received the strong winds earlier in the day.

The area covered by the storm's circulation was expanding as it absorbed another LOW. The SEA-LAND COMMERCE was close to 40°N, 174°W and headed into 45-kt gales. The seas were 20 ft. Further north and east the KYOKUYO MARU had 35-kt gales on her starboard side. The pressure had dropped to 971 mb. At 1800 on the 29th, the LOW crossed into the Bering Sea, and within 30 hr was absorbed by a LOW that moved out of Siberia.

This LOW formed, on the 30th, in the col area between typhoon Polly and a LOW in the Bering Sea. It moved rapidly to the northeast, deepening as it went. By 0000 on September 1, the pressure had plunged to 972 mb and was centered at 52°N, 167°E. The DAISHIN MARU was about 90 mi south of the center and battled 50-kt winds on her bow. The seas were 16 ft and the swells 30 ft from the southwest. The DURBAN MARU, southeast of the center, near 48.5°N, 176°W, contended with 35-kt gales. Twelve hours later, the winds and waves had not subsided for the DAISHIN. The SANTA CATALINA MARU reported 45-kt winds driving 15-ft seas and 20-ft swells at 48.2°N, 164.8°E. The LOW was now drifting westward and made a loop near 50°N, 170°E.

On the 2d, the GOLDEN ARROW was about 150 mi south of the center and was beaten by 45-kt gales. The waves were up to 16 ft. The OJI MARU, about 100 mi southeast of the center, reported 40-kt gales.

On the 3d, the LOW was again moving northward and filling. This relaxed the gradient, and another LOW moved south of it further reducing the wind speeds. On the 5th, the LOW became stationary in the vicinity of Mys Olyutorskiy until it disappeared on the 7th.

There was no storm this month worthy of the title "Monster of the Month."

Tropical Cyclones, Western Pacific--Tropical storm Lucy flared up briefly east of the Luzon Strait on the 9th. Winds reached 40 kt with gusts to 50 kt near her center. By the 10th she was moving northward trying to squeeze through the Formosa Strait. She couldn't make it, and on the 11th Lucy petered out between Taiwan and mainland China.

Meanwhile, 300 mi east of Saipan a large sprawling storm was coming to life. Mary was developing at a time when a strong monsoon was covering most of the Philippine Sea. This enlarged her circulation to the point where she wreaked havoc on Guam some 360 mi to the west-southwest. Peak gusts of 57 kt from 250° were recorded at Andersen Air Force Base on the 12th and 13th. Gusty winds exceeding 30 kt began on the 12th and persisted through the 14th while Mary moved slowly northward then northwestward.

The 25,794-ton Panamanian passenger ship CARIBIA en route from New York City to Kaohshung, Taiwan, where she was to be scrapped, went aground in

Figure 39. --The CARIBIA was scrapped ahead of time, on the breakwaters, at the entrance to Apra Harbor, by then tropical storm Mary. Not long after this picture was taken she broke in two and the stern part slid into the channel. Pacific Daily News, Photo by P. J. Ryan.

the entrance to Apra Harbor, Guam, on the 12th (fig. 39). The harbor had to be closed for several days. The German tug HAMBURG was towing the ship when they encountered heavy seas about 3 mi from Guam. The tug captain cut the ship loose, and it finally lodged on the rocks near the breakwater. Several smaller vessels were also driven aground. Another tug, the SAKURA MARU, riding out the storm west of Guam, was forced to cut loose her tow of drydocks on the 12th.

The Island of Guam bore some damage to power-lines, trees, and crops. Two people died including a 7-yr-old girl who drowned while swimming in a pond; the other was a 19-yr-old U. S. sailor who drowned while surfing.

On the 15th near Chichi Jima Mary turned west-northwestward. Meanwhile little Nadine was coming to life in the Philippine Sea near 16°N, 126°E and drifting eastward. Nadine reached tropical storm strength and turned northeastward on the 16th while Mary was heading for the Ryukyu Islands. Big Mary, while staying below typhoon strength, had gales that extended out to 400 mi in her eastern semicircle (fig. 40). She reached typhoon strength briefly on the 18th in the East China Sea while Nadine was weakening as she made her way toward the coast of Honshu. On the 18th Nadine fell to depression strength near 30°N, 140°E but continued to move northwestward bringing some rain

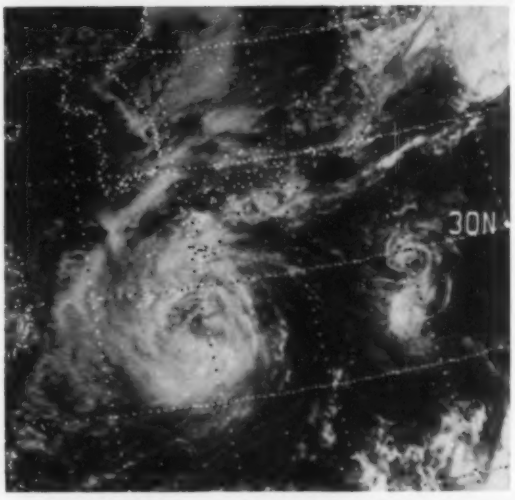


Figure 40. --Big Mary, little Nadine - Mary's circulation stretches to China, Taiwan, Honshu, and South Korea dwarfing Nadine, to the east, late on the 17th.

to southern Honshu. One day later Mary collapsed as she collided with mainland China, about 100 mi south of Shanghai. Confused and disorganized, the remnants of the storm rebounded back into the East China Sea. On the 23d Mary began to get it together again. She slashed her way across Okinawa and back into the open Pacific on the 24th. The following day proud Mary was a raging typhoon steaming northeastward toward Honshu. Maximum winds were 65 kt with gusts to 80 kt. As Mary neared the coast she fell to tropical storm strength. She beached near Lake Hamana, south of Nagoya. Floods and landslides were common as Mary dumped up to 20 in of rain over the mountainous regions of Chubu and Kanto. She continued to weaken as she crossed Honshu on the 26th.

While Mary was beating herself out over Japan, Polly was developing right near Saipan and Rose was blooming east of Taiwan. It took Polly just 2 days to become a typhoon, which she did on the 27th about 120 mi north of Saipan. She was moving north-northwestward. The following day Rose became a tropical storm as she moved northeastward. Polly's winds reached 100 kt on the 29th as she passed Iwo Jima. Rose's winds were around 50 kt on the 29th as she brushed Okinawa. However, Rose weakened and turned eastward on the 30th. She dropped to tropical depression strength on the 31st and was gobbled up by Polly who was by this time to the north, near 30°N, 136°E (fig. 41), and closing in on Japan.

Maximum winds were 90 kt near Polly's center as she neared Shikoku. She crossed the island on the 1st of September bringing strong winds and heavy rains to

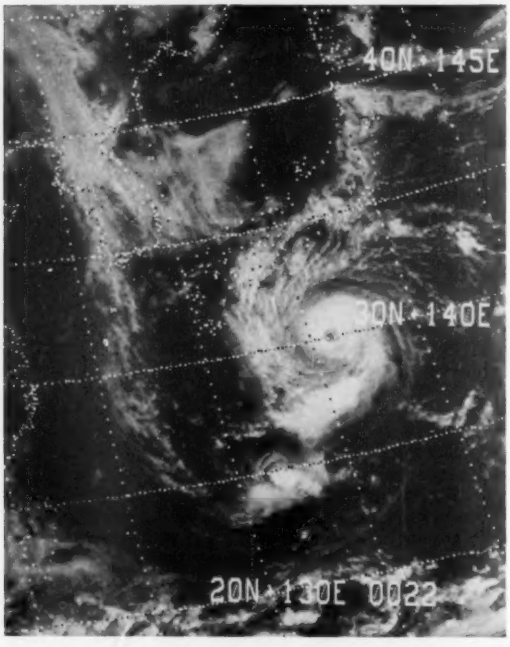


Figure 41.--Typhoon Polly heading for Japan, on the 31st, pauses to absorb a tiny rambling Rose to the south.

both Shikoku and Honshu. Kochi reported 107-kt winds and Cape Muroto clocked winds at nearly 90 kt. Up to 20 in of rain were dumped over the region. Four people were killed in the resultant floods and landslides. The typhoon continued across southern Honshu and into the Sea of Japan unleashing strong winds and heavy rains over a wide area. The Tokyo metropolitan area suffered one of its worst floods in years despite the fact that it was not hit directly. Polly turned extratropical in the Sea of Japan on the 2d.

Tropical Cyclones, Central Pacific -- Tropical storm Olive flared up briefly in the central Pacific. She was first sighted as a depression, on the 23d, near 13°N, 152.5°W. Moving west-northwestward at about 10 kt she intensified to tropical storm strength early the following day. Early on the 24th, maximum sustained winds reached 40 kt near her center while gales extended out 75 mi in all directions. However, before the day was through Olive had dropped back to a depression near 14°N, 156°W.

Tropical Cyclones, Eastern Pacific--The intertropical convergence zone was quite active near 10°N from the coast westward to 140°W early in August. A number of tropical disturbances formed but none developed into an organized system until August 9 near 13°N, 109°W. A review of satellite pictures gave no clue as to why this particular area developed more vigorously than others, and observations from the thinly scattered vessels in the area were not sufficient to help.

The depression moved toward 300° at 8 to 10 kt, a course and speed it maintained during gradual intensification to tropical storm Helga, at 1800 on the 10th, near 14°N, 114°W. That course, speed, and intensity continued to near 16°N, 121°W, at 1800 on the 11th. Gradual weakening took place and by 1800 on the 12th the tropical storm became a tropical depression. Twenty-four hours later the depression had dissipated near 16°N, 124°W.

The only vessel near Helga was the MEDER LEK at 1800 on the 10th. She reported a west-southwest wind of 20 kt and a pressure of 1008.1 mb 125 mi east-southeast of the storm. The strongest wind indicated in advisories was 40 kt, and that for only one 6-hr period.

Satellite pictures during the morning of the 17th showed increased activity on the intertropical convergence zone near 12°N, 114°W. By the end of the day, a disturbance was identified and tracked westward at 16 kt. The westward speed slowed to about 10 kt as development took place, reaching tropical storm intensity near 14°N, 128°W, at 1800 on the 20th.

Tropical storm Ione, with 35-kt winds, curved a little southwestward and weakened to a tropical depression on the morning of the 22d and then continued west to near 12.5°N, 138.5°W, at 1800 on the 23d. Morning satellite pictures showed considerable intensification had taken place since the infrared pictures taken the night before, and the depression was raised to hurricane classification with 65-kt winds.

Ione continued intensifying, with 100-kt winds by 0600 on the 24th, as it curved into the Honolulu area of responsibility near 13°N, 140°W. The hurricane was moving west-northwestward at 10 kt with winds of 80 to 100 kt. The track curved slowly northward

and, by 1200 on the 26th, Ione was centered near 17°N, 144°W. She then moved a little east of north, slowing and weakening rapidly on the 27th: from a hurricane with 70-kt winds at 1200 to a tropical storm with 50-kt winds at 1800 and to a tropical depression with 30-kt winds at 0000 on the 28th.

The MARCONA TRANSPORTER overtook Ione during the period of the 22d to the 26th, passing about 105 mi northwest of the center at 1800 on the 25th. The maximum winds she reported were 30 kt, the highest seas 10 ft, and swells of 16 ft with a period of 14 sec.

As tropical storm Ione decreased to a depression early in her life, two disturbances were forming at nearly the same latitude, 600 mi and 1,500 mi to the east. The more interesting of these was near 13°N, 110°W, an area of thunderstorms and squalls in which no center of rotation was apparent from the few peripheral ship reports. After viewing a movie loop of ATS-3 pictures taken on the 21st, it was evident that a circulation had begun near 14°N, 109°W. The depression moved northwestward and slowly intensified to become tropical storm Joyce at 1800 on the 22d near 15°N, 110°W.

The other disturbance developed into a depression near 14°N, 124°W, at 0600 on the 22d, and by 1800 had increased in intensity to tropical storm Kirsten.

Tropical storm Joyce, moving northwestward at 10 kt, increased in intensity to 60-kt winds, at 1800 on the 23d, near 17°N, 112.5°W, to 70 kt at 0000 on the 24th, to 75 kt at 1800 near 17°N, 116°W, and then began a gradual decline.

While Joyce was developing into a hurricane, and midway to tropical storm Kirsten, a tropical depression was forming near 11°N, 117°W. The depression developed rapidly into tropical storm Lorraine with 35-kt winds near the center and was moving northwestward at 8 kt as indicated by infrared photographs.

Another depression, this in the Central Pacific, formed near 13°N, 151.5°W, and began developing. A rare photograph of tropical cyclone activity is seen in figure 42. From right to left: hurricane Joyce, tropical storm Lorraine, hurricane Kirsten, hurricane Ione, and tropical storm Olive. Four active storms at one time in the eastern North Pacific is a rare occurrence. The only other time four named storms could be found was in 1966. There is no known record of five storms at one time in the eastern and central North Pacific as shown in the satellite composite picture.

Tropical storm Joyce, with 60-kt winds, was moving westward at 7 kt near 19°N, 120°W, at 0000 on the 26th, when tropical storm Maggie formed near 12°N, 105°W, shortly after Ione moved into the central Pacific. By 2100, the winds had increased to hurricane strength again (70 kt) near 19°N, 122°W. Joyce decreased to a tropical storm near 19°N, 125°W, at 0600 on the 27th, and by 1800 was a 30-kt tropical depression rapidly dissipating.

No vessel reported more than 20-kt winds during the life cycle of Joyce, but also none reported closer than about 300 mi of the center.

A series of tropical depressions and disturbances was occurring between 10°N and 15°N and from 105°W to 135°W on the 22d. One near 14°N, 124°W was moving northwestward at 15 kt at 0600. The depression was caught between Ione to the west and Lorraine to the east. It slowed as it intensified to become tropical storm Kirsten near 15°N, 126°W at 1800.

Further slowing to 8 kt and intensification to hurricane strength occurred prior to 0000 on the 24th near 16.5°N, 130.5°W. A vessel 120 mi south of the center reported 60-kt winds at that time. At 1200 the tuna boat CABRILLO reported 50-kt winds 100 mi

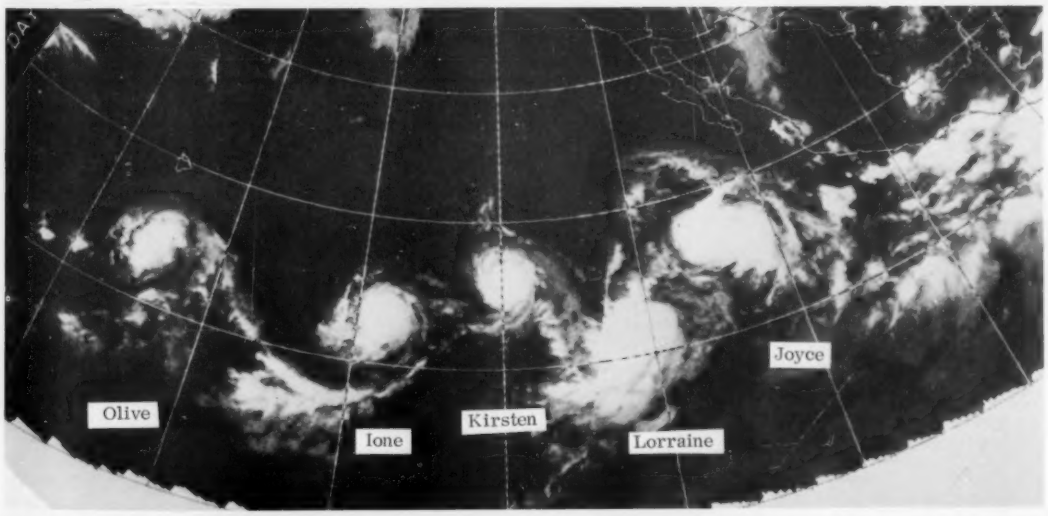


Figure 42.--A rare photo of Pacific quintuplets. On August 23d, five tropical cyclones were in various stages of development at the same time in the same ocean area. They are from left to right: tropical storm Olive, hurricane Ione, hurricane Kirsten, tropical storm Lorraine, and hurricane Joyce.

from the center.

The storm was nearly stationary and torn between interacting with Joyce to the west or Lorraine to the east. At 1200 on the 25th she weakened to a tropical storm near 16.5°N, 126.8°W and chose Lorraine by heading southeastward. Kirsten weakened to a tropical depression near 14°N, 127°W, at 0000 on the 29th, and special bulletins on her were discontinued.

A disturbance developed into a tropical depression near 11°N, 118°W, some 480 mi southwest of Joyce and 600 mi east-southeast of Kirsten, at 0000 on the 23d. The depression was moving northwestward at about 8 kt with winds of 30 kt in squalls near the center. Six hours later satellite pictures indicated it had intensified to tropical storm Lorraine.

The northwestward movement continued, through 1200 on the 24th, to near 12°N, 121°W, followed by a 10-kt northeastward movement, through 1800 on the 26th, to near 15°N, 117°W. Another jog in the track toward the northwest continued until 17.5°N, 119.5°W was reached and the storm weakened to a depression. The depression then moved southwestward, weakened, and finally dissipated near 17°N, 122°W, at 0600 on the 28th.

Vessels whose observations helped locate and track the storm included the IWATI MARU, the TUGELA, GRED, and GZPZ.

A disturbed area near 10°N, 105°W, at 1200 on the 25th, became a depression by 1800 as indicated by the USNS SEA LIFT, and PDOG. These reports suggested a closed circulation and a low central pressure. The depression intensified to tropical storm Maggie, at 0000 on the 26th, near 11.5°N, 105°W. Movement was toward the northwest at about 5 kt.

Satellite cameras followed the development to hurricane intensity, at 1800 on the 26th, with 65-kt winds near the center. Further intensification developed winds of 120 kt for an 18-hr period, beginning 0600 on the 28th, after which gradual weakening took place. Air Force reconnaissance aircraft made seven fixes on the storm, reporting wind speeds of 110 kt at 1800 on the 27th (fig. 43), 120 kt at 1800 on the 28th, 115 kt at 0000 on the 29th, 85 kt later on the 29th, and 65 kt on the 30th. Maggie became a tropical storm at 0400 on the 31st, moving westward at about 10 kt, from 19°N, 116°W. Weakening continued for another 42 hr until the storm became a depression, near 20°N, 120°W, with 30-kt winds at 1800, September 1.

The lowest pressure reported on the surface was 999.7 mb at Socorro Island when Maggie was about 60 mi south of the island at 1800 on the 28th. A short time earlier an Air Force reconnaissance plane had dropped a radiosonde into the eye. The lowest pressure measured by it was 934 mb. The observer on board the aircraft reported "extremely strong winds from approximately 5 mi from the center into the eye wall." At that time the eye had a radius of 9 mi and was circular.

Casualties--There were no reports of casualties in the North Pacific other than those associated with tropical cyclones and described above. There was a report of heavy weather damage to the 5,592-ton CANTERBURY STAR in the South Pacific. She encountered heavy weather, on the 14th and 15th, on a voyage from New York to Sydney.

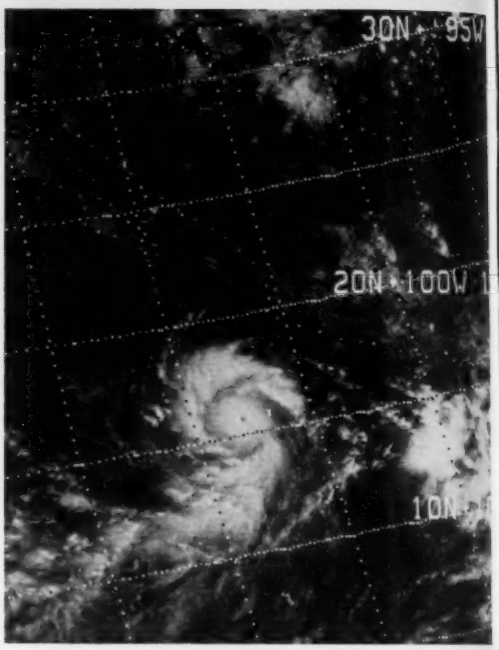


Figure 43.--Hurricane Maggie, shown here on the 27th, formed on the 25th. A few days earlier and it could have been sextuplets.

ROUGH LOG, SEPTEMBER 1974--Climatology indicates that the most prominant primary storm track this month stretches from Honshu to southwestern Alaska, crossing the Aleutians near Adak. Another less traveled path comes out of the eastern U.S.S.R., across Sakhalin Island, and joins the previous track in the southern Bering Sea. A third track forms about 50°N, 160°W and proceeds northeastward into the Gulf of Alaska.

The storm tracks this month were much more diffuse than usual. The track out of the U.S.S.R. was normal, except it stopped in the Sea of Okhotsk. The track from Japan split into two branches, one into the western Bering Sea, and the other south of the Aleutians into the western Gulf of Alaska. The track from midocean was more northerly. The number of cyclones was near normal.

The mean pressure pattern was more chopped up than normal. The Pacific High normally has a 1021-mb main center near 36°N, 145°W, and a 1017.7-mb subcenter near 35°N, 165°E. This month there were five centers: the highest was 1019 mb off Vancouver Island, with four 1018-mb centers stretched along approximately 35°N between 135°W and 170°E. The 1016-mb isobar looked like a large U lying on its left side, with the right side covering western Canada and northeastern Alaska. This resulted in higher than normal pressure over that entire area.

The 1007-mb climatological Aleutian Low is centered over Cape Romanzof, Alaska. This month the low-pressure area consisted of four subcenters. A 1009-mb center was located in the open center of the

high-pressure U, near 55°N, 158°W. A 1012-mb center was slightly east of the Kamchatka Peninsula. A 1009-mb Low was near 48°N, 130°E, in northern Manchuria with a 1010-mb subcenter over the northern tip of Sakhalin Island.

The largest anomaly in the area was a positive 9-mb center over the Beaufort Sea. A positive ridge extended south-southwestward from this center across the central Bering Sea, another ridge extended south-southeastward along the Rocky Mountains. A small positive center was located over the Kuril Islands. The only significant negative anomaly was 6 mb centered near 40°N, 150°W.

There were seven tropical cyclones in the North Pacific, five in the west and two in the east. They were typhoons Shirley, Virginia, and Agnes; tropical storms Trix and Wendy, and hurricanes Norma and Orlene.

Except for typhoon Shirley, the first 2 weeks of September were relatively quiet. One storm extended into the month from August, and the first storm started early in the second week, but did not develop into a significant storm until late in the week.

The LOW had its inception between Honshu and Hokkaido on the 8th. It tracked northeastward off the Kuril Islands as a minor wave until it entered the circulation of another LOW over the northern Sea of Okhotsk on the 10th. The combined circulation then turned southeastward as extratropical Shirley approached from the southwest. The track was following a path north of the Aleutian Island chain (fig. 44) and slowly deepening. Gale-force or greater winds had yet to be generated.

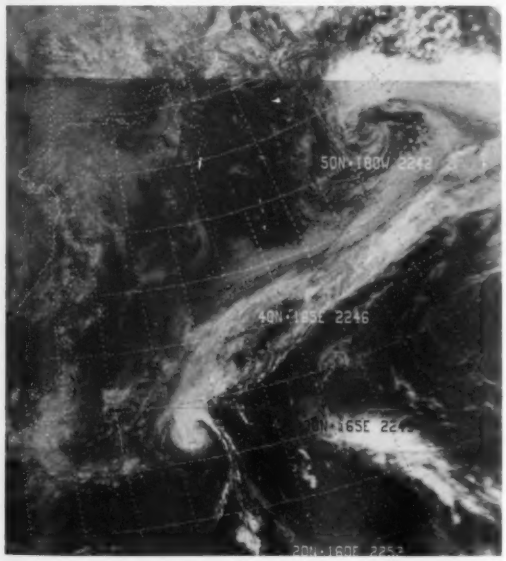


Figure 44. --Late on the 12th, the extratropical LOW is located near 52°N, 176°W. Typhoon Virginia is located near 32°N, 152°E, and weak extratropical Shirley, though not clearly defined by the cloud pattern, is near 41°N, 169°E.

On the 13th, the LOW crossed south of the islands and the winds increased. At 1200, the LOW was 979 mb near 54°N, 167°W (Unalaska Island). The SUMMIT was near 53°N, 171°W with 45-kt northerly winds and heavy rain. The seas were 15 ft and the swells were 20 ft. At 0000 on the 14th, the 7KTK, about 52°N, 168°W, also experienced 45-kt gales with 15-ft seas and 26-ft swells.

As the storm moved into the Gulf of Alaska it had its lowest pressure of 977 mb on the 15th. At 0000 the center was near 52.5°N, 160°W, and the WAKAURA MARU was near 46°N, 165°W with 40-kt winds. The direction of movement was turning northward at a slow pace as the surface LOW was almost vertically aligned with the upper-air LOW. Minimum gale-force winds were periodically reported as the storm weakened. Late on the 17th, the center crossed the Alaska Peninsula in a westerly direction, and on the 18th disappeared into another system over the Bering Sea.

This LOW at first glance seemed to appear on the weather chart out of nowhere, over the Bering Sea. A closer examination shows it was probably a consolidation of the circulation of several weak LOWs, located around the edge of the Bering Sea, including the one just described above. The 1200 chart of the 17th showed a ridge extending northward into the Bering Sea with three diffuse LOWs extending down the Siberian Coast, and a dissipating LOW over the Alaska Peninsula.

By 0000 on the 18th, the ridge had retreated southeastward and a 997-mb LOW was centered near 57°N, 179°E. About 450 mi to the south, the ESSO KAGOSHIMA was hit by 50-kt winds just behind the cold front. The LOW moved southeastward and crossed the Aleutian Islands about 0000 on the 19th. At 0000 on the 20th, the PACSTAR was about 300 mi west of the 994-mb center with 40-kt winds on her port side. Later in the day, the major circulation combined with another LOW, and a third LOW developed giving a long north-south shape to the system.

On the 21st, the northern LOW split off to the north and the new LOW to the south became the dominant system. It traced a fishhook-shaped path as it moved counterclockwise, circling back north-northwestward before disappearing on the 23d.

An unstable wave formed on a front just south of Osaka, Japan on the 24th. It increased in amplitude as it moved northeastward and, by 0000 on the 25th, was a 1004-mb LOW near 39°N, 147°E. The DAIGOH MARU was northeast of the center and reported 40-kt southeasterly winds. Twelve hours later, she was buffeted by 45-kt southerly gales and heavy rain as she moved eastward and the storm moved northeastward. The FREESIA was near 43°N, 153°E and rocked by 50-kt portside winds. Her pressure had fallen 5.5 mb in the past 3 hr.

At 0000 on the 26th (fig. 45), the storm was small with a 997-mb center, near 45°N, 155°E. The KINYO MARU and MONTIRON both reported 40-kt gales along 44°N, at 159° and 157°E, respectively. The LOW continued tracking northeastward outside the Kuril Islands and increased its area of circulation, but the pressure remained constant.

On the 27th, it turned southeastward and started to fill as a high-pressure area built over the Bering Sea. By the 30th, the LOW was defeated by the HIGH.

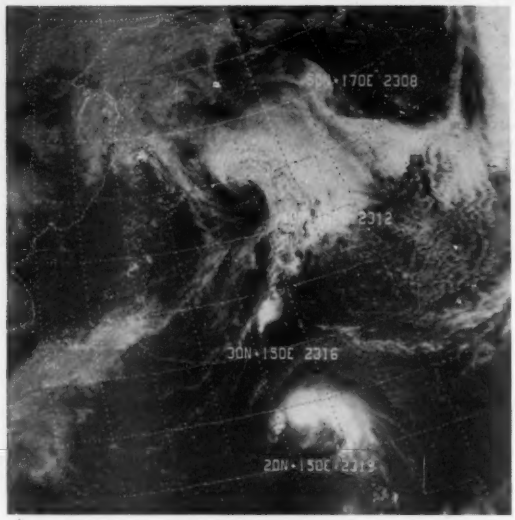


Figure 45. --Although a small storm on the surface analysis, the clouds extend many miles to the east. Tropical storm Agnes is located near 24°N, 153°E.

A cutoff LOW had wandered around (fig. 46) in the mid-Pacific since the 24th. On the 29th, it started moving northeastward as the upper-air LOW combined with a major trough. This loss of upper air support spelled its doom, though, as another surface LOW developed farther to the northeast. This new LOW moved and deepened rapidly. By 0000 October 1, it was a 982-mb storm located near 55.5°N, 144°W. The AH JIN, 53.5°N, 152°W, and the THAMES MARU, 52.5°N, 146°W, both reported 35-kt gales. At 1200 the CHEVRON CALIFORNIA, near 57°N, 145°W, had 40-kt gales from the north on her port side.

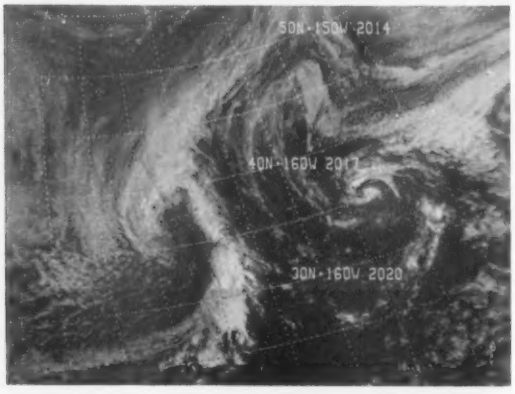


Figure 46. --At 2017 on the 26th, the diffuse storm center is near 38°N, 172°W. The north-south cloud band defines a weak front. The closed circulation near 36°N, 153°W was not nearly so clearly outlined on the surface.

By that afternoon, at 0000 on the 2d, the CHEVRON CALIFORNIA was churning through 50-kt winds and 18-ft swells. The HILLYER BROWN, off Montague Island, and the NEWARK, at 56.7°N, 144.4°W, both contended with 45-kt gales. The ESSO NEWARK, near 54.5°N, 142°W, had only 35-kt gales, but the seas were running 20 ft. The CALIFORNIA appeared to be standing offshore as she remained in the same general area with the winds still blowing at 45 kt, and rode 15-ft seas and 18-ft swells. Late on the 2d and early on the 3d, the storm blew out against the mountainous shore with only a trough remaining.

Monster of the Month--The monster of the month would have to be one of the several vicious tropical cyclones that occurred in both the Atlantic and Pacific.

Tropical Cyclones, Western Pacific--On Sunday night (8th) typhoon Shirley, packing 70-kt sustained winds along with 85-kt gusts, moved over Kyushu, Japan. She dumped 5 to 17 in of rain on both Kyushu and Shikoku. These torrential downpours triggered flooding and landslides that resulted in 13 deaths and thousands of damaged homes. Transportation, power, and communication facilities were all disrupted. Shirley was first detected as a tropical depression, on the 4th, about 200 mi southeast of Okinawa. She intensified quickly. Before the 4th was out Shirley was a tropical storm. She was on a northwestward path. By the 6th she was a typhoon, moving through the Ryukyus. Shirley turned northeastward toward the Japanese mainland on the 7th (fig. 47).

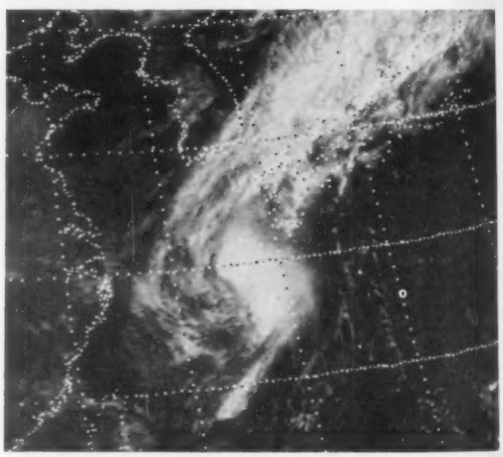


Figure 47. --Typhoon Shirley is advancing towards Kyushu early on the 8th.

As Shirley was developing into a typhoon, tropical storm Trix flared up briefly off the China coast. She developed about 100 mi south of Hong Kong on the 5th. Moving northwestward Trix became a tropical storm the following day as winds near her center reached 40 kt with gusts to 50 kt. However, she was too close to the coast to develop further and a few hours later rammed ashore near Tien-pai, China.

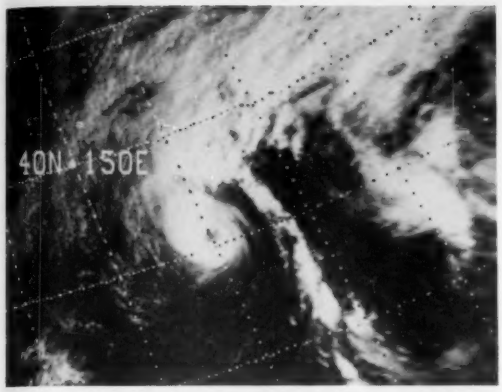


Figure 48.--Shapely typhoon Virginia is caught intensifying in northern Pacific waters late on the 13th.

On the 12th a tropical depression was discovered near 31°N, 151°E. It drifted northeastward and 12 hr later, at 0000 on the 13th, was typhoon Virginia. The typhoon was already pretty far north (fig. 48), but she continued to intensify. On the 14th, near 37°N, 156°E, Virginia's maximum winds were estimated at about 80 kt with gusts to 100 kt. Gales extended out 150 to 200 mi. The PRESIDENT VAN BUREN, about 200 mi north of the center, encountered 45-kt winds and 23-ft swells. After this Virginia began to weaken and turn extratropical. She still packed some punch, however, as attested to by the AKAISHI MARU, which battled 55-kt winds close to Virginia's center at 0000 on the 15th. By the 16th, with her center near 41°N, 155°E, winds were down to 40 kt and the storm was extratropical.

There was a one-week lull before Wendy and Agnes came to life. Tropical storm Wendy was spotted, on the 24th, in the South China Sea midway between Hainan and northern Luzon. As a depression she moved across northern Luzon that same day. Wendy reached tropical storm strength as she came off the Island. She then turned northward, on the 25th, and moved slowly through the Luzon Strait during the next few days. During this period Wendy fluctuated between tropical storm and tropical depression intensity but, on the 27th, winds near her center increased to 60 kt with gusts to 75 kt. At this time she was moving northward just off the east coast of Taiwan.

While Wendy was hesitating in the Luzon Strait, Agnes was springing to life near Marcus Island. She developed into a tropical storm on the 25th (fig. 45), south of Marcus Island, and reached typhoon strength, on the 27th, about 200 mi northwest of Marcus Island. The following day Agnes began to recurve east-northeastward, but she continued to intensify. On the 30th, after crossing the 30th parallel near 155°E, winds near her center climbed to 105 kt gusting to 130 kt. Winds of 100 kt extended out 50 mi while gales extended nearly 200 mi in all directions. The OCEANIC PEACE encountered 40- to 50-kt winds some 200 mi southwest of the storm center. After reaching this peak Agnes' intensity began to drop as she started an extratropical transformation. By the 2d, near 44°N, 173°E, Agnes had dropped to tropical storm strength and soon after she became extratropical. However, the TOSEI MARU ran into 45-kt winds in 20-ft seas some 250 mi southeast of Agnes' center.

While Agnes was heading into the midlatitudes, Wendy was moving across northern Taiwan and stalling in the Formosa Strait. She crossed the rugged Island, on the 28th, as a tropical storm. Once into the Strait she slowly faded and, by the 30th, was a weak stationary depression. Wendy was, however, responsible for the sinking of the 4,099-ton Somali freighter SUN SANG about 400 mi east of Hong Kong. Three men were rescued from heavy seas by a Japanese tanker, but the rest of the ship's 34-man crew perished.

Tropical Cyclones, Eastern Pacific--Large areas of showers and thunderstorms developed between 10°N and 15°N from 95°W to 112°W on September 7. The area began breaking into cells, on the 8th, and at 1800 a circulation was indicated by reports from the NANCY LYKES and the RENATTOW, each with 20-kt winds and 1010-mb pressures about 100 mi north and south of the center near 13.5°N, 99°W.

Further organization was slow, but the area developed into tropical storm Norma, near 15°N, 100°W, before 1800 on the 9th (fig. 49), as indicated by a report from the ANGELBURG, with 40-kt winds and 25-ft seas near 16°N, 100°W. At 0000 on the 10th, JBZY reported 40-kt winds 40 mi north of the center and the OLGA JACOR reported 45-kt winds 60 mi to the northeast. Intensification to hurricane strength was indicated by satellite pictures, at 0211 on the 10th, near 15.8°N, 100.8°W.

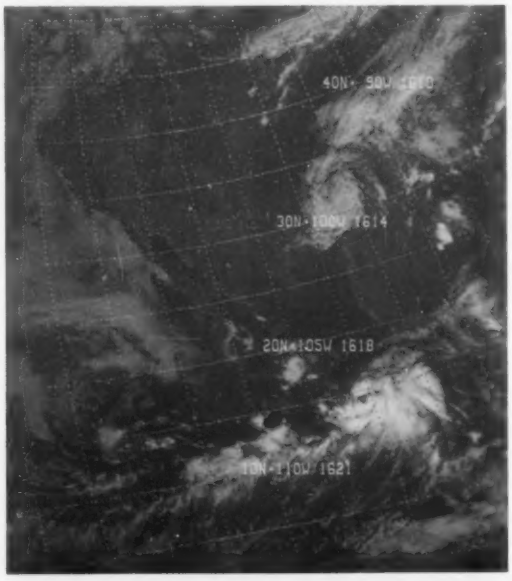


Figure 49.--About 11 hr later, tropical storm Norma reached hurricane intensity. Hurricane Carmen is almost due north.

Norma moved north-northwestward at 5 to 8 kt, reaching the coast about 1500 on the 10th, about 60 mi west of Acapulco. Strong southwesterly winds continued for 24 hr in the offshore waters. The MARITIME ACE reported 35-kt winds and 16-ft swells with 16-ft seas 200 mi south of Acapulco and the NICHIWA MARU reported 25-kt winds and 13-ft seas with 13-ft swells 400 mi south of Manzanillo at 1800 on the 10th.

The continued flow of moisture to the southwest brought heavy rains to the mountainous coastal areas, and the resulting earth slides caused at least three deaths in the Acapulco area. No report of damage has been received from vessels.

As the Caribbean hurricane Fifi moved inland over Honduras the night of the 19th, a tropical depression was forming near 14°N, 96°W. Winds of 30 to 35 kt were reported by the POSTMAR, 9MTZ, and 3EZP, near the Gulf of Tehuantepec, as the remains of Fifi crossed the Continental Divide.

The depression moved northwestward at about 4 kt and joined the upper air circulation and energy associated with the remains of Fifi, which had moved westward at about 20 kt, to near 17°N, 98°W, at 0600 on the 21st. The merging increased the intensity of both, and tropical storm Orlene was formed with 40-kt winds.

The storm, first reported as having developed over land, was just offshore at 1200 and then moved westward at about 10 kt to near 17°N, 103°W at 0000 on the 22d. Orlene continued moving at about 10 kt but curved northward reaching 19°N, 106°W, at 0000 on the 23d, with winds of 50 kt near the center. Northward curvature continued through the night of the 23d. Acceleration followed as the track became a little east of north. Air Force reconnaissance of the storm indicated 59-kt winds 20 mi east of the center which was

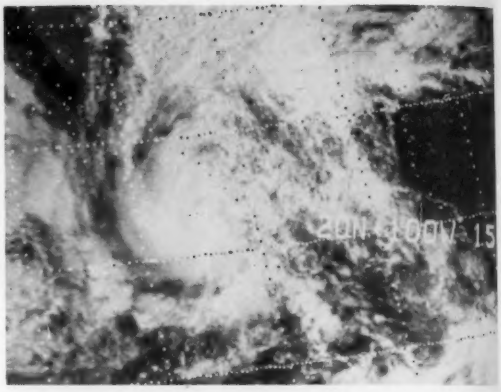


Figure 50.--Hurricane Orlene (ex Fifi), just prior to measurement of 110-kt winds at 2300 by Air Force reconnaissance.

then at 23.4°N, 107.4°W at 2100 (fig. 50). Two hours later, they reported rapid intensification to 110-kt winds near 23.8°N, 107.4°W at 2245.

A short time later the hurricane moved inland between Culican and Manzanillo. Heavy rains and gusty winds accompanied the storm inland but the winds subsided quickly and no reports of damage have been received.

Casualties--There were no weather-connected casualties that came to our attention this month, other than those connected with typhoons Shirley and Agnes.

Marine Weather Diary

NORTH ATLANTIC, DECEMBER

WEATHER. December is generally one of the sotrmiest months of the year over the North Atlantic, particularly north of 35°N. Deep and extensive LOWs traverse the middle and northern shipping lanes, producing strong winds and high seas. Extended periods of rain, sleet, or snow usually attend these storms. A comparison with the normal pressure pattern of the preceding month shows that in December the Azores High remains at about 1021 mb and is centered near 35°N, 33°W. The Icelandic Low deepens 1 mb to 1001 mb; it is located near 62°N, 38°W.

WINDS from the westerly quarter prevail over most of the ocean north of 40°N. Speeds average force 5 to 6 over most western and central waters, and about force 4 over the Bay of Biscay and surrounding waters, the Baltic Sea, and the southern portion of the North Sea. Force 5 to 6 southeasterlies prevail over the northern half of the North Sea, while southerlies of force 4 to 5 are predominant off the central coast of Norway. Winds over the Norwegian Sea are variable at about force 5. Between 40° and 30°N, winds (force 3 to 4) are westerly or southwesterly west of 20°W, northerly or northeasterly between 20°W and the Strait of Gibraltar, and predominantly westerly over the Mediterranean Sea. The "northeast trades," also averaging force 3 to 4, persist between 30° and 10°N, except off the east coast of Florida where winds are variable at force 4. As in November, force 3 southeasterlies prevail over the extreme southern North Atlantic.

GALES. The occurrence of gales is more frequent over northern and middle latitudes than in November. Winds of force 8 or higher occur 10 percent or more of the time from about 34°N over the western North Atlantic to about 40°N over eastern waters. A 10-percent frequency of gales is encountered on the Mediterranean Sea within an area extending nearly 200 mi southeastward from the Gulf of Lions. The incidence of gales is less than 10 percent over the immediate waters east of Newfoundland and over the Davis Strait. Areas of maximum gale frequency--20 percent or higher--are found within an area from the Labrador Sea southeastward to about 44°N, 35°W, then north-northwestward to 56°N, 40°W, then eastward to 55°N, 24°W, then north-northwestward again to the cold waters off southeast Greenland; over much of the Norwegian Sea; and over the Gulf of Lions.

EXTRATROPICAL STORMS. Two primary storm tracks--one from the waters east of the United States Middle Atlantic States and one from the northern Great Lakes--converge over Newfoundland and then head toward Greenland, where they split into two tracks with one leading into the Davis Strait and the other

heading toward Iceland. A large number of LOWs also head toward Iceland from the central ocean east of 40°W and north of 50°N. Another cyclone track enters the Davis Strait from Hudson Bay, while still another runs across the northern coast of Norway from the Norwegian Sea. A primary track stretching from the Gulf of Lions to west-central Italy and then east-southeastward to the south coast of Turkey influences the Mediterranean area. The Great Lakes have their highest cyclone frequency of the year during December. The frequency of cyclogenesis over the Gulf of Mexico also reaches it annual maximum during December.

TROPICAL CYCLONES. There is seldom a tropical storm on the North Atlantic in December. During the 43-yr period, 1931-73, only two were recorded; one of these reached hurricane strength.

SEA HEIGHTS of 12 ft or higher occur 10 percent or more of the time north of a line extending from the northwest coast of Spain to approximately 35°N, 70°W, and then east of a line joining that point with Nova Scotia. On the Norwegian Sea, however, sea heights $\geq$ 12 ft usually occur less than 10 percent of the time. Ten-percent frequencies are also found in the Mediterranean between Balearic Islands, Sardinia, Tunisia, and the French Riviera; between Sicily and Crete; and on the northern Aegean Sea. Maximum frequencies of 30 percent or more occur over the Denmark Strait and over much of the western and central ocean north of about 47°N and south of the 60th parallel. An isolated area of 20-percent frequency rests over the Gulf of Lions.

VISIBILITY. The frequency of visibility less than 2 mi climbs to 10 percent over the Labrador Sea, over a pocket-shaped area extending from Kap Farvel south-southwestward to the Grand Banks, over the southern and eastern Davis Strait, and over the southern North Sea. Frequencies of this low visibility are also greater than 10 percent over the area north of a line drawn from the Denmark Strait eastward across northern Iceland, then dipping southward to about 64°N, 7°W, then stretching north-northeastward over the Norwegian Sea, and then eastward to the northern coast of Norway. North of about 72°N, the frequency of visibility less than 2 mi increases to 20 percent and continues to increase as one moves eastward until, after reaching the southern Barents Sea north of the Soviet Union, frequencies reach a maximum of 40 to 50 percent.

NORTH PACIFIC, DECEMBER

WEATHER. December is usually a stormy month over North Pacific waters, particularly in the northern and middle latitudes. The normal pressure distribution is quite similar to that of the preceding month with the Aleutian Low (1001 mb) shifting to near southeastern Kamchatka.

WINDS north of 55°N blow mostly from a northerly direction at force 4 to 6, except over the Gulf of Alaska where force 4 easterlies prevail. Westerly winds of force 3 to 6 are usually felt south of 55°N to about 40°N over the extreme eastern ocean, 35°N over the central-eastern and midocean, and 30°N west of 165°E and east of Japan. Nevertheless, winds over the southwestern Bering Sea show a tendency to be variable, and off the coast of British Columbia the prevailing wind is southerly. Steady "northeast trades" prevail (force 4) between 25°N and the Equator, except they extend to nearly 35°N off the southwestern California coast. These trade winds merge with the force 4 to 5 winds of the northeast winter monsoon near 140°E. Variable winds (force 3 to 4) lie in a narrow belt between the aforementioned westerlies and northeasterlies. Prevailing winds are largely from the north or northwest and average about force 4 over the Sea of Japan, and the Yellow Sea, and along the southeast coast of Japan. Northerly winds blow steadily out from the Gulf of Tehuantepec, off the south coast of Mexico.

GALES. A larger area of the North Pacific is subject to gales during December than in the preceding month. North of about 39°N over eastern and central waters and 32°N over western waters, 10 percent of the observations contain winds of force 8 or higher. The greatest frequencies, 20 to about 25 percent, occur in three scattered areas from the waters south of the southern tip of the Kamchatka Peninsula south-southeastward to about 34°N, 166°E. Farther north, the frequency of gales decreases to less than 10 percent over the Sea of Okhotsk and the Bering Sea. They are also under 10 percent across a triangularly shaped area southeast of the Aleutians bounded at 53°N, 162°W; 47°N, 163°W; and 49°N, 174°W. Gales are recorded between 5 and 10 percent of the time on the waters surrounding Taiwan, the southern Ryukyus, and the northern portion of Luzon as far east as 144°E, because of the strong development of the northeast monsoon. Gale-force northerly winds occur between 5 and 10 percent of the time out from the Gulf of Tehuantepec.

EXTRATROPICAL CYCLONES. Primary storm tracks extend from the northern portion of the Sea of Japan and the waters east of the Ryukyus to the ocean region lying between Kamchatka and the western Aleutians. From there, LOWs either pass near the Pribilof Islands or continue east-northeastward to the Gulf of Alaska. Another major storm track reaches the Gulf of Alaska from an area south of the Alaska Peninsula near 48°N. The only other primary cyclone track swings toward Vancouver Island from a point 450 mi west of the Oregon coast.

TROPICAL CYCLONES. One tropical storm usually develops over the western North Pacific during December. About two out of every three that do pop up go on to become typhoons. The most likely area of formation is in the neighborhood of the Caroline Islands. Contrary to the events of November, very few of these storms are able to maintain their identity over the South China Sea after traversing the Philippines.

Off the Mexican west coast, tropical cyclones are rare in December.

SEA HEIGHTS of at least 12 ft occur 10 percent or more of the time north of approximately 35°N, east of 150°E, and south of the Alaska mainland, the Aleutian Islands, Kamchatka, and 55°N on the Sea of Okhotsk.

VISIBILITY under 2 mi occurs 10 percent or more of the time north of a line drawn from the lower Tatar

Strait to the central Kurils and then northeastward to the western Aleutians where it dips southeastward to about 47°N, 177°W. Upon reaching a point near 47°N, 165°W, the line bends generally northward to Cape Romanzof, Alaska. A much smaller area of 10-percent frequency is centered near 44°N, 143°W. Visibility less than 2 mi encompasses more than 20 percent of all observations poleward of a line cutting through the northern and eastern portions of the Sea of Okhotsk, the northern Kurils, and then northeastward through the Bering Sea to the Bering Strait (passing west of both the Komandorskiye Islands and St. Lawrence Island). A smaller area comprising a 20 percent or greater frequency lies north of the central Aleutians near 54°N, 173°W.

NORTH ATLANTIC, JANUARY

WEATHER. January is generally characterized by rough weather over the middle and northern latitudes of the North Atlantic. LOWs frequently become deep, and associated winds often reach gale and sometimes hurricane force. The Icelandic Low (1000 mb), centered off the extreme southeastern tip of Greenland, is deeper than at any other time of the year. The Azores-Bermuda High with a central pressure of about 1023 mb covers a band from the western Mediterranean Sea west-southwestward to the waters northeast of the Bahamas.

WINDS. North of 40°N, the prevailing winds are westerly over most of the ocean. Over the Norwegian Sea and the North Sea, winds from the southerly quarter prevail. The average wind speeds are predominantly force 4 to 6, except up to 1,200 mi south and east of the southern tip of Greenland and over the Labrador Sea where they reach force 5 to 7. Between 25° and 40°N, the wind direction is from the southwest quarter of the compass over the main body of that portion of the Atlantic, mostly easterly over the Gulf of Mexico, variable over the waters east of Florida, and northerly or northeasterly from west of the Iberian Peninsula to the Canary Islands. Westerlies still dominate over the Mediterranean Sea. Force 3 to 4 winds are the most common except off the coast of the middle Atlantic United States where force 4 to 6 winds prevail. From the Equator to 25°N, the "northeast trades" persist; more than 65 percent of the time wind speeds range from force 3 to 5, except south of 10°N where these winds blow more than 50 percent of the time.

GALES (winds force 8 and higher) occur in 10 percent or more of the observations north of 35°N over the western part of the ocean and north of 40°N over the eastern part. The Mediterranean Sea hosts 10-percent frequencies out to 150 mi from the Gulf of Lions, over the northern Adriatic Sea, and over most of the Aegean Sea. The highest frequency over all North Atlantic waters, 30 percent, is found over a small area centered at about 58°N, 30°W, over a narrow belt off the southern tip of Greenland between 38° and 52°W, and (because of the mistral) over the Gulf of Lions.

EXTRATROPICAL CYCLONES. During the winter months (December, January, and February) LOWs form most frequently in a band 150 to 250 mi wide stretching from the North Carolina - South Carolina border northeastward to about the latitude of Cape Cod. This is part of a large area of cyclogenesis that extends from the Gulf coast of the United States northeastward to the Bay of Fundy. Other principal areas of cyclogenesis lie over the western half of the central ocean between Newfoundland and the British Isles, over most Icelandic coastal waters, over the inland waters east of the North Sea except the Gulf of Bothnia, and over the Mediterranean from the Gulf of Lions southeastward to the toe of Italy and then northward to the Yugoslavia coast. Cyclogenesis is more concentrated around the waters on both sides of central Italy than anywhere on the North Atlantic during winter with the exception of the band off the United States Atlantic coast. In January, primary storm tracks run from the Carolina capes to Cape Race and from Lake Superior to Cape Bauld. After reaching Newfoundland, cyclones either head northward to the Davis Strait or the Denmark Strait or northeastward to Iceland. Primary storm tracks are also present off the northern Norwegian coast, over the Mediterranean from the Gulf of Genoa to Cyprus, and over the eastern Great Lakes where they join the track toward Newfoundland.

SEA HEIGHTS greater than 12 ft occur 10 percent or more of the time north of 33°N over the western North Atlantic and north of 42°N over eastern waters. Frequencies greater than 10 percent also exist in a small area near Barranquilla, Colombia, and on the Mediterranean between Menorca and Sicily (not including the waters surrounding Corsica), south of Greece and west of Crete, and on the northern Aegean Sea. A large area of frequencies greater than 30 percent stretches from south of Iceland to west of Ireland to east of the Grand Banks and then northward to the waters southwest of Greenland and south of the waters between Greenland and Iceland. Smaller areas of similar frequency are found on the Denmark Strait and west of northern Norway near 67°N, 10°E. The frequency of sea heights greater than or equal to 12 ft decreases to less than 10 percent over a large portion of the Norwegian Sea north of 67°N between 5°E and about 13°W.

VISIBILITY less than 2 mi is noted in more than 10 percent of the observations from Cape Sable eastward to the Grand Banks and northward to Cape Mercy, over the Denmark Strait and the northwestern portion of the Norwegian Sea, and over the southern portion of the North Sea. The frequency increases to more than 20 percent in the Resolution Island area and over the Norwegian Sea north of about 70°N.

NORTH PACIFIC, JANUARY

WEATHER. The most severe weather of the year occurs generally in January over the middle and northern latitudes of the North Pacific. The circulation over the ocean is controlled mainly by the major centers of action--the Aleutian Low, the subtropical High, and the Siberian High. All except the subtropical High are near or at their peak seasonal development. The Aleutian Low, with a central pressure of 1000 mb, is southeast of Kamchatka near 50°N, 165°E, while the axis of the Pacific subtropical ridge exceeds 1021 mb from about 30°N, 135°W, east-northeastward to the state of Wyoming. The wind regime near the Asiatic coast from the Korea Peninsula to the South China Sea is controlled principally by the clockwise flow around the Siberian High (1036 mb), situated over Asia near 49°N, 96°E.

WINDS. Westerly winds prevail over much of the ocean north of 30°N and west of 180°. Northerly winds dominate the East China Sea. Winds are variable over the western Aleutians, southeasterly over the central Aleutians, and northeasterly near the Pribilof Islands. From the Gulf of Alaska southward to near 40°N and east of 180°, winds are mostly westerly to southerly, although other directions are common during the frequent passage of LOWs. Over the extreme northern Gulf of Alaska, the prevailing winds are easterly, and northerly winds are very pronounced over the Bering Sea north of 60°N. The average speed of winds north of 30°N is force 4 to 6, although southeast of Kamchatka the wind blows at force 7, 21 percent of the time. The "northeast trades" extend northward to near 25°N over most of the western and central ocean and to 30°N over eastern waters; south of 20°N, these winds are very steady. The wind speeds in the trades range from force 3 to 5. The "northeast monsoon" is steady over the South China Sea and the Philippine Sea south of 30°N and west of 150°E. Winds are quite variable over the eastern North Pacific between 30° and 40°N, southwesterly over the east-central ocean between 25° and 40°N, and variable over west-central waters between 25° and 30°N and 150°E and 180°. Wind speeds over the above three areas are usually force 4. Northerly winds predominate over the Gulf of Tehuantepec, and in 65 percent of the observations they range between force 2 and 6.

GALES. The frequency of gales near and above 10 percent affects most noncoastal areas south of the Aleutians and north of a line from the waters southeast of Honshu to a point south of the Queen Charlotte Islands and west of Washington State. A maximum incidence of over 20 percent is found over a relatively large region southeast of Kamchatka, over a smaller area east of northern Honshu near 39°N, 154°E, and south of the Gulf of Alaska near 50°N, 145°W. Gale-force northerly winds are encountered more than 10 percent of the time by vessels plying the Gulf of Tehuantepec off southern Mexico. These violent squally winds occur when strong northers from the Gulf of Mexico funnel across the isthmus to the Pacific. In extreme cases, they may be felt more than 200 mi out at sea.

EXTRATROPICAL CYCLONES. Principal areas of cyclogenesis during winter are found from Taiwan on the southwest to the northern Kurils and lower Sakhalin on the northeast and from just north of Marcus Island on the southeast to the western shore of the Sea of Japan on the northwest. The Yellow Sea and Korean coastal waters are not included in this vast region of cyclogenesis. Other smaller areas of cyclogenesis lie over the Pribilof Islands, the Gulf of Alaska, off the North American coast from the Queen Charlotte Islands southward to northern California, and over the east-central ocean about midway between the Aleutian and the Hawaiian Islands. The migratory LOWs move mostly northeastward from the East China Sea and Hokkaido to the western Aleutians and then east-northeastward to the Gulf of Alaska. Other primary tracks approach the Gulf of Alaska and Vancouver Island from the southwest.

TROPICAL STORMS are infrequent in January. On the average, two can be expected every 5 yr over the western North Pacific. Most of these storms develop between 6° and 10°N and west of 150°E and move toward the southern half of the Philippines. Three out of every five January tropical storms achieve typhoon strength.

SEA HEIGHTS greater than 12 ft occur more than 10 percent of the time in an area extending northward from 30° to 35°N to a line drawn from Kodiak Island to the central Aleutians and then to the southeastern waters of the Sea of Okhotsk, and westward from a line 700 mi off the coast of southeastern Alaska and 500 mi off the Oregon coast to 150°E.

VISIBILITY less than 2 mi occurs in 10 percent or more of the observations over an area of the eastern North Pacific between 40° and 50°N and 141° and 162°W, and northwest of a line drawn from Hokkaido to the western Aleutians and then northeastward along the Aleutian chain to the Alaska Peninsula and Cape Avinof. A maximum frequency of over 30 percent encloses a small area over the Okhotsk Basin southwest of Kamchatka.

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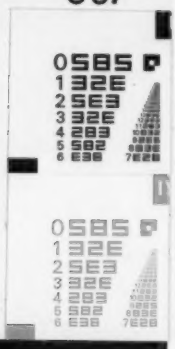
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